79/

A GUIDE
TO
PHOTOGRAPHY,

CONTAINING SIMPLE AND CONCISE DIRECTIONS FOR OBTAINING

Views, Portraits, &c.,

BY THE CHEMICAL AGENCY OF LIGHT, INCLUDING THE MOST RECENT AND IMPROVED PROCESSES FOR THE PRODUCTION OF

COLLODION POSITIVES AND NEGATIVES,

INCLUDING ALSO THE

CALOTYPE AND WAXED PAPER PROCESSES,

TOGETHER WITH CLEAR INSTRUCTIONS FOR THE NEW

COLLODIO-ALBUMEN, OR DRY GLASS PROCESS,

Printing Positives on Paper,

AND THE METHOD OF TAKING

STEREOSCOPIC PICTURES,

&C., &C.,

BY
W. H. THORNTHWAITE,
AUTHOR OF "PHOTOGENIC MANIPULATION," ETC.

THIRTEENTH EDITION.

Illustrated with numerous Woodcuts.

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PREFACE

TO THE THIRTEENTH EDITION.

In this, as in the former editions, I have followed the plan which experience has proved the most successful for teaching the beautiful Art of Photography, viz.: — A plain description of the simplest and most successful method of taking pictures in each of the approved processes now in use; confining myself, as far as possible, to one method of manipulation and proportion of chemical mixture, in preference to a multitude of various proportions and methods, which would tend rather to bewilder a beginner than prove a "Guide."

W. H. THORNTHWAITE.

November, 1856.

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PHOTOGRAPHY.

BY W. H. THORNTHWAITE,

AUTHOR OF "PHOTOGRAPHIC MANIPULATION," ETC., ETC., ETC.

CHAPTER I.

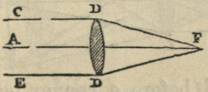
INTRODUCTORY REMARKS.

THE art of making pictures by the agency of light may be designated under the general term photography—a term derived, as is well known, from the two Greek words *phos*, "light," and *grapho*, "I write or delineate," and includes various specific operations to which the appellations of Calotype, Talbotype, Daguerreotype, and the Collodion processes, have, at different periods and on various occasions, been given.

Before describing the requisite Lenses and other apparatus necessary for prosecuting the art of Photography, a short description of the chief optical properties of light will tend greatly to facilitate the correct understanding of the meaning of several terms employed in connexion with lenses.

One of the most important optical properties of light, is that termed refraction, or the bending of a ray of light when passing through a transparent substance, such as air, water, glass, &c., and it is to this property that the peculiar action of lenses is due. When a convex lens is directed towards a luminous object placed at an infinite distance, as the sun for instance, a bright and luminous spot will be observed on a piece of paper held at a certain distance behind the lens. Now, this spot is called the principal *focus*, or focus of parallel rays of the lens; and its distance from the lens is the focal length, which depends upon the convexity of the lens; the greater the amount of convexity the shorter the focus. In the accompanying figure, D D may represent a lens, and C A E parallel rays of light, which on passing the lens will be refracted, and, by meeting, form a focus at F.

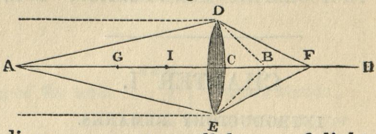
Fig. 1.



Again, if the lens be directed towards an object, the rays from which are not parallel but divergent, as is the case with objects at a short distance,

the focus F, or the point where the rays meet, will be at a greater distance from the lens, and a sheet of paper held at that point will show an *inverted image* of the object; and, if the distance of the object from the lens be made to vary, it will be found that the nearer it is to the lens the greater the distance the sheet of paper requires to be held behind the lens, to get a clear representation of the object, and *vice versâ*. This will, perhaps, be better understood by reference to the following cut—

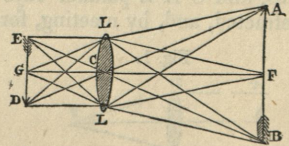
Fig. 2.



Let the dotted lines represent parallel rays of light falling on the lens D E, and refracted to the principal focus B, and let A D, A E, be rays diverging from the point A: they will converge, after passing the lens, towards the point F, where they intersect each other, and form an image of the point A; and, if the lens be brought nearer to the radiating point A, the focus F will be lengthened, and *vice versâ*. These alterations in the focal distance follow certain rules; for suppose the point A to be placed at G, a point equal to twice the principal focal distance C B, the focus F will be at H as far behind the lens as the radiant point G is before it. If A be placed at I, the focus will be infinitely distant, or the refracted rays will become parallel, and will not form an image; finally, if A be placed between I and C, the rays diverge after refraction. Either of the points A or F may be considered as the focus, for, if the radiant point be F, its image will be formed at A, in the same way that A will produce an image or focus at F; it is to this relation or interchange between the radiant points and foci that the term has been given of *conjugate foci*.

The formation of images in that well-known instrument, the *camera obscura*, is due to a convex lens placed in the front of the instrument. It has been before mentioned, that all images formed by a convex lens are reversed, and consequently inverted. Now, the reason of this, and also of the formation of an image, will be better understood by referring to the following cut;—

Fig. 3.



If A F B is an object placed before a convex lens, L L, every point of it will send forth rays in all directions; but for the sake of simplicity, suppose only three points to give out rays, one at the top, one at the middle, and one at the bottom, the whole of the rays then that proceed from the

point A and fall on the lens L L, will be refracted and form an image somewhere on the line A C D, which is drawn direct through the centre of the lens; consequently the focus D, produced by the convergence of the rays proceeding from A, must form an image of A, only in a different relative position; the middle point of F being in a direct line with the axis of the lens, will have its image formed on the axis G, and the rays proceeding from the point B will form an image at E; so that by imagining luminous objects to be made up of an infinite number of radiating points, and the rays from each individual point, although falling on the whole surface of the lens, to converge again and form a focus or representation of that point from which the rays first emerged, it will be very easy to comprehend how images are formed, and the cause of those images being reversed.

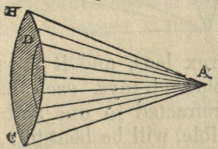
It must also be evident that in the two triangles, A C B and E C D, that E D, the length of the image, must be to A B, the length of the object, as C D, the distance of the image, is to C A, the distance of the object from the lens.

This last rule will point out the method to be followed if images are required of a certain determinate size; for example, if C F is equal to C G, the image E D will be of the same size as the object A B; if C F is as long again as C G, the image will be half the size of the object; if, on the contrary, C F is half the length of C G, the image E D will be double the size of the object A B.

A knowledge of this principle is of some importance, inasmuch as the relative sizes of the image and object can be determined beforehand, and thus allow more extended applications to be made of those instruments by means of which photographic pictures are obtained.

If two lenses be used of the same focus, the images produced by one may be rendered much more brilliant than those produced by the other, by having the former of larger diameter; for instance, if one of the lenses were two inches and the other one inch in diameter, the former would intercept four times the quantity of light more than the latter, and it is evident the image produced would be four times as brilliant; for example, the cone of light, A B C, in the accompanying figure, would be entirely

Fig. 4.

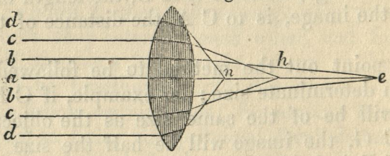


intercepted by the lens B C, while the lens D would only intercept a small part; so, when it is not possible to increase the brightness of the object by illuminating it, the brightness of the image can always be increased by using a larger lens.

Care must be taken not to confound *brightness* with clearness; they are two things totally different, and the gaining of one does not in general depend upon the other; for it is necessary, in many cases, to stop a portion of light from falling on the lens, by which means a much sharper picture is obtained.

When rays of light fall on an ordinary convex lens, they converge, as before noted, to what is called a focus; if this be carefully examined it will be observed that a perfectly exact coincidence of the rays, or in other words an exact focus is not produced, those rays striking the edges of the lens being more bent or refracted to a focus nearer to the lens than those towards the centre portion; this want of coincidence in the rays which pass through the central and outer portions of a lens, is termed *spherical aberration.* This may be more easily understood by observing the accompanying cut, *a*, *b*, *c*, *d*, representing the rays of light, and *e*, *h*, *n*, their respective

Fig. 5.



foci. When a ray of light thus suffers refraction it is decomposed into various colours; this is beautifully shown by passing a ray of sun light through a glass prism, when it becomes entirely dispersed or separated into seven distinct colours or mixture of colours, in the following order: *red*, *orange*, *yellow*, *green*, *blue*, *indigo*, and *violet.* Now, as the action of all lenses is due to refraction, it becomes impossible to obtain a focus which will not be fringed more or less by this decomposed light; this is called *chromatic aberration*, and its effect will be better understood by the following diagram:—

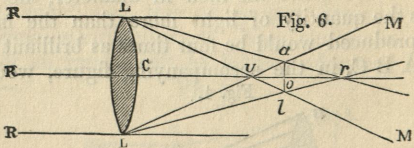


Fig. 6.

If L L be a double-convex lens, and R R parallel rays of white light, composed of the seven coloured rays, each having a different *index* of refraction, they cannot be refracted to one and the same point; the red rays being the least refrangible, will be bent to *r*, and the violet rays, being the most refrangible, to *v*: the distance *v r* constitutes the chromatic aberration, and the circle, of which the diameter is *a l*, the place or point of mean refraction, and is called the circle of least aberration. If the rays of the sun are refracted by means of a lens, and the image received on a

screen placed between C and o, so as to cut the cone L a l L, a luminous circle will be formed on the paper, only surrounded by a red border, because it is produced by a section of the cone L a l L, of which the external rays, L a L l, are red; if the screen be moved to the other side of o, the luminous circle will be bordered with violet, because it will be a section of the cone M a M l, of which the exterior rays are violet. To avoid the influence of spherical aberration, and to render the phenomena of coloration more evident, let an opaque disc be placed over the central portion of the lens, so as to allow the rays only to pass which are at the edge of the glass; a violet image of the sun will then be seen at v, red at r, and, finally, images of all the colours of the spectrum in the intermediate space; consequently, the general image will not only be confused, but clothed with prismatic colours.

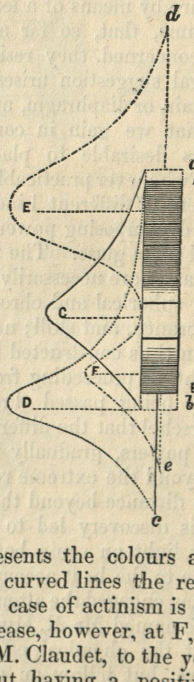
The two aberrations, namely, the spherical and chromatic, are the two great difficulties the optician has to overcome so as to produce a perfectly sharp and clear focus or picture by means of a lens. It will be observed by reference to preceding diagrams, that, so far as the errors of chromatic and spherical aberration are concerned, they reside chiefly in the edges of a lens; hence the most natural suggestion arises, of cutting off these rays altogether by means of a curtain or diaphragm, and this is one of our most frequent resources. But what we gain in correctness by this we lose in illumination; hence it is desirable to place one's self beyond the necessity of using diaphragms whenever practicable. This can only be accomplished by constructing the lens of different kinds of glass, having different amounts of refractive and decomposing power upon lights, such as the varieties of flint, crown, and plate glass. The investigation of the relative curves in which the various glasses are necessarily to be employed, to compensate, as far as possible, both spherical and chromatic aberration, is a work of the greatest nicety, perseverance, and skill; nevertheless it can be accomplished, and when it has been thus constructed it is termed achromatic.

When a ray of white light, as proceeding from the sun, is decomposed into its primitive colours by being passed through a prism, it was discovered by Sir William Herschel that the different colours of the spectrum possessed different heating powers, gradually increasing from the violet, where it was the least, to beyond the extreme red; and that the maximum temperature existed at some distance beyond the red, and out of the visible part of the spectrum. This discovery led to the inquiry, whether the chemical effect produced by light on some bodies, especially some of the compounds of silver, was due to the heat accompanying it, or to some other cause. This investigation has engaged the attention of several modern philosophers, among whom may be named Mr. R. Hunt and Sir J. F. W. Herschel, who have demonstrated that the chemical effects of light are not due to the heat present in the rays, but follow an entirely different law, being greatest at the violet end of the spectrum, where the heating power is least, and least at the red, where the heat is the greatest.

This fact is easily demonstrated by causing the prismatic spectrum to fall on a sheet of paper impregnated with chloride of silver, when the paper will become blackened at the violet end, and even beyond any visible rays of light, the effect gradually decreasing as we approach the red. This experiment and several others of a like character have given rise to the idea, that there must be some peculiar fluid accompanying light, which produces all the chemical changes that we find to be produced by light in our photographic experiments. The terms *energia* and *actinism* have each been proposed as a name for this supposed fluid; and, although both are open to the objection of not being sufficiently definite in their signification, the latter term, actinism, is the one now usually adopted.

Light may, therefore, be said to be made up of three separate and distinct fluids, producing actinic, luminous, and heating effects, and the relation of these to each other is shown in the following cut:—

Fig. 7.



The shaded portion represents the colours as they occur in the decomposed solar beam; and the curved lines the relative amount of *actinism*, *light*, and *heat*, which in the case of actinism is greatest at E, and ceases at *d* and *e*, having a slight increase, however, at F, which may be due, according to some experiments of M. Claudet, to the yellow rays being not merely negative in their action, but having a positive destructive influence on the effects produced by actinic rays. Light is most intense at C, and ceases altogether at *a* and *b*; and heat is greatest at D, disappearing at *a* and *c*.

CHAPTER II.

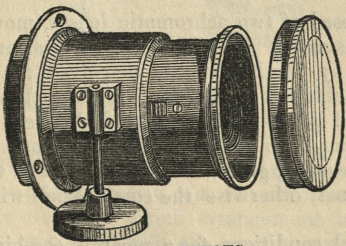
PHOTOGRAPHIC APPARATUS,

THEIR CONSTRUCTION AND USE; INCLUDING LENSES, CAMERAS, CAMERA STANDS, PRINTING FRAMES, &c., &c., &c.

PHOTOGRAPHIC LENSES.

The varieties of lenses required for producing photographic pictures may be classed under the following heads: *for Views*, *Portraits*, and *Copying*. They are constructed on the achromatic principle, as it may be termed, described at page 5, with this important variation, *that the actinic or chemical rays must be made to coincide with the luminous rays, or those which produce the picture as viewed by the eye on the ground glass.** It is from this circumstance that achromatic lenses such as those employed for telescopes, opera glasses, &c., are not suitable for photographic purposes.

Fig. 8.



VIEW LENSES.

These are usually mounted in a brass tube sliding within another tube, and actuated by rack and pinion, for the purpose of adjusting the focus (fig. 8). In the front is a brass cap for the purpose of opening and closing the aperture. The stops, or circular pieces of brass with holes in the centre of different sizes, are placed in front of the lens, at a distance equal to its diameter. The size of stop to be employed will depend upon the brightness of the day on which the view is taken—the brighter the object, the smaller the stop to be employed. Another circumstance which will also regulate the size of the stop, will be the deviation of the objects composing the view from one plane—the greater the space between them, or in other words, the nearer the fore-ground, or the greater the distance to be taken, the smaller the stop to be employed.

* Lenses of foreign manufacture are generally deficient in this particular.

The form of the view lens is Meniscus, or concavo-convex, and is formed of a double convex lens of plate glass, cemented to a double concave lens of flint glass. The lens should be kept clean by being carefully wiped, from time to time, with a piece of soft wash-leather. The proper position of the lens when in the mounting (represented at fig. 8) is the convex surface outwards, so that, when the mounting with the lens is screwed to the front of the camera, the convex surface is inside the camera, and the concave surface towards the stop.

Fig. 9.

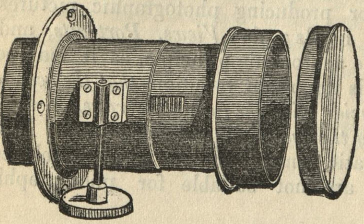
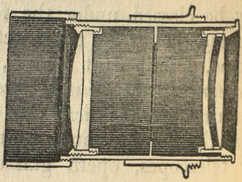


Fig. 10.



PORTRAIT LENSES.

These are composed of two achromatic lenses, mounted in a brass tube with rackwork adjustments (fig. 9.) The proper arrangement of the lenses is shown at fig. 10, by which it will be perceived, that the two flint lenses, or those having the thickest edges, are towards each other. The two back lenses have a small piece of tube placed between them to keep them slightly separate from each other. When the lenses have been removed for the purpose of cleaning, great care should be taken that they are returned in the proper manner, otherwise the combination will not work with its usual distinctness.

The most essential conditions for a portrait combination of lenses are, quickness of action, fineness of definition, and *depth of focus*; this latter quality is of great moment for the production of first-rate portraits, otherwise only those parts which are on the same plane come out sharp and distinct, and instead of all the features and dress being equally sharp, the eyes, or part focussed, may be so, but the point of the nose or other projecting parts of the figure become enlarged, distorted, and out of focus.

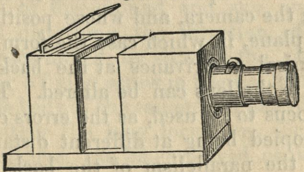
The most perfect, convenient, and generally useful arrangement of lenses, combining all these essential requirements in an eminent degree, are those manufactured by Messrs. Horne and Thornthwaite, which are arranged so as to perfectly answer for both views and portraits. Fig. 10 represents a section of one of these lenses, showing the position of the lenses for portraits; when required for views, the front lens and mounting A is unscrewed, and screwed into a separate brass mounting, similar to fig. 8; it then forms a perfect view lens and the same remarks apply to it as have been made relative to view lenses.

COPYING LENSES.

These are employed, in conjunction with the copying camera, for the purpose of copying photographs on an enlarged or diminished scale; the action will be understood on reference to fig. 3, page 2; they are also particularly applicable for taking photographs from prints, pictures, and other subjects having a perfectly flat surface. The view lens will answer in the copying camera for enlarging or diminishing photographs, but not so perfectly as a lens constructed expressly for that purpose, as the relative proportion of the parts of the copy to the original are apt to be altered. The usual form of the lens is double convex, one side being more convex than the other, and when used, the more convex side is turned towards the photograph or copy if it is required to be enlarged, or away from it if to be diminished.

PHOTOGRAPHIC CAMERAS

Fig. 17.



EXPANDING CAMERA.

A very convenient form of camera is that represented at fig. 17; it is termed the expanding or double-bodied camera; it consists of two portions, one sliding within the other, by which arrangement both the view and portrait lenses can be employed with the same instrument. The back portion has an aperture into which the dark frame slides for holding the prepared glass or paper, and also the focussing glass frame. It has also a projecting piece of brass and a fixing screw at the back, so as to retain it in its position when the focus is nearly obtained, the final adjustment being accomplished by the rack and pinion of the lens.

This camera is attached to either of the forms of camera stand (figs. 30, 31 and 32, page 18), by a screw (fig. 19), which passes through the top of the stand, and screws into a brass plate fixed at the bottom of the camera.

When a camera is required of the greatest possible strength, and at the same time to combine as much convenience and portability as possible, the form represented at figs. 18 and 18* is employed. Fig. 18 represents the camera open for use, and Fig. 18* the same when rendered portable. The arrangement is similar to the expanding camera, with this difference, that the tail-board, or portion upon which the moving back slides, is hinged so as to turn up and protect the ground focussing glass from injury.

Fig. 18.

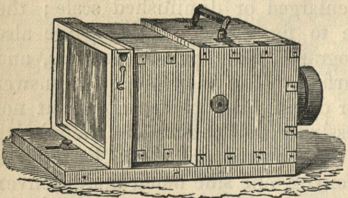


Fig. 18.*

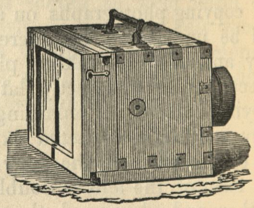
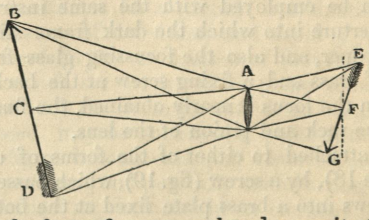


Fig. 19.

This form of camera is fixed to its stand by a metal screw (fig. 19) which passes through the stand, and screws into a brass plate attached either to the bottom or to the side of the body D. It is often furnished with brass bands or ties when to be used in very hot and damp climates.

In some instances it is required to obtain representations of objects at a short distance from the camera, and whose position varies very considerably from a vertical plane, in which case the form of camera is employed, which has a mechanical contrivance at the back, whereby the relative position of the plate to the lens can be altered. This arrangement allows a lens of very short focus to be used, as the errors caused by various parts of the object to be copied being at different distances are, in great part, remedied by altering the parallelism of the back frame and the object-glass. This effect will be better understood by reference to the following diagram (fig. 20) and what has been before explained relative to conjugate foci at page 2.

Fig. 20.



Let A represent the lens of camera placed opposite the object, B C D, in the position represented—it will be evident that the only point where a correct focus would be obtained on a vertical plane, represented by a dotted line, would be at F, but by shifting the position of the back to E F G, as shown in the cut, the whole of the object may be brought into focus.

Fig. 21.

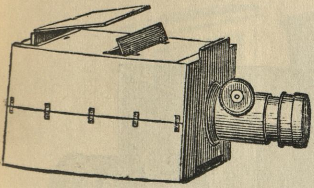
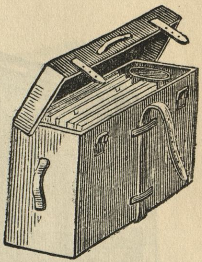


Fig. 22.



FOLDING CAMERA.

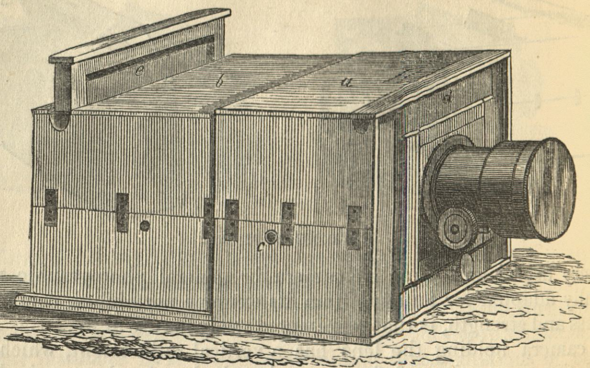
A very useful and complete camera for general photographic purposes, especially adapted for tourists, from its extreme portability, combined with lightness and strength, is that represented ready for use at fig. 21. The front of the camera holding the lens has a vertical adjustment, which enables the relative proportion of fore-ground and sky, in the required picture, to be altered without disturbing the direction of the camera. When the best position is ascertained, by viewing the picture as formed on the ground glass, tightening a fixing screw in front of the sliding piece will prevent it shifting. In the body of the camera are placed two or more openings, or slides, by which either the long focus lens for views, or the shorter combination for portraits, &c., can be employed, as desired. At the bottom and side of this camera are two apertures for attaching it to the camera stand.

Fig. 19 represents the brass screw employed for this purpose. It is passed from below through the camera stand, and screwed into the bottom brass plate of the camera, if the view is required of greater breadth than height; or into the side plate of the camera, if the height is wanted to be greatest.

The hole not in use in the camera must be closed with a cork or some other convenient substance. In the best manufactured instruments, however, these holes are kept closed downwards from the inside by some mechanical contrivance, one of the most effective being a pin of brass, just fitting the hole, fixed to a flat spring within the camera; this can easily be pushed back and placed on one side, so as, when required, to fix the camera to the stand.

When the camera is not required for use, it can be removed from the stand, the lens unscrewed, the front and slides lifted from their grooves, and the body of the camera folded together by the hinges, as shown in the cut, by which arrangement the camera box, together with the slides for prepared paper, glass, or silver plates, frame for ground glass, &c., can be conveniently packed, and in the smallest possible space, in leather case as shown at fig. 22.

Fig. 24.



FOLDING AND ADJUSTING CAMERA.

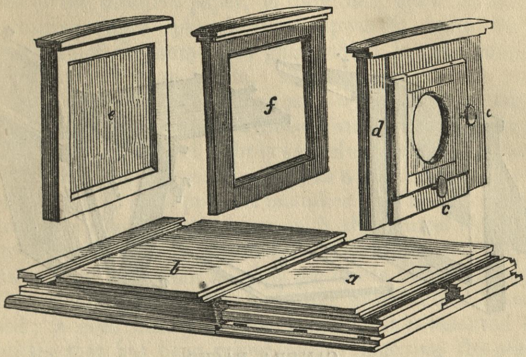
This most convenient and useful form of camera, represented set up ready for use (fig. 24), combines all the facilities of adjustment possessed by the expanding camera (fig. 17), together with the convenience, portability, and lightness of the folding camera (fig. 21.) It consists of two folding portions, *a* and *b*, the part *b* containing the dark frame sliding within the portion *a*, by which arrangement lenses of different focal lengths can be used with equal facility, and rendering this camera peculiarly suitable for the view and portrait combinations described at pages 7 and 8.

The cut, fig. 25, on the opposite page represents the camera when rendered portable, the three portions *d*, *e*, and *f*, although shown just over the parts in which they are to be placed when the camera is put up for use, lie, when packed together with the camera backs (figs. 26 and 27), flat on the body of the camera, and thus take up but little room in travelling.

To arrange the camera for use, raise the front portion *a*, and slide in the adjusting front *d*, which is secured in its place by pushing out with the thumb two small sliding bolts situated inside the top of the camera. The portion *b* is now to be lifted up, and the frame *f* slid into its place, nearest to the body *a*, and retained by two sliding bolts similar to the front part. The frame *f* thus performs the double purpose of a support for the sliding portion *b*, and an inner diaphragm, which considerably improves the picture and prevents internal reflection.

When the focus is nearly obtained by sliding the body *b* in or out of the front portion *a*, it can be secured firmly in its position by a nut and screw passing through the bottom board; the final adjustment is then obtained, in the usual manner, by the rack-work of the lens.

Fig. 25.



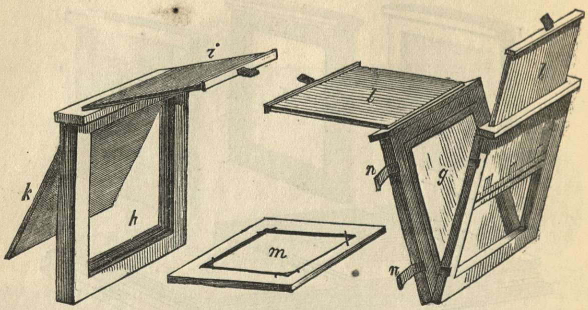
This form of camera is fixed to any of the camera stands (figs. 30, 31 and 32) by a screw which is passed through the bottom of the stand, and screwed into one or other of the brass plates fixed to the bottom or side of the camera. This arrangement allows either a view or portrait to be taken in an upright or longitudinal position, according as the camera is placed on the stand.

GROUND GLASS OR FOCUSSING SCREEN.

This consists of a frame of wood containing a plate of glass very finely ground, and fits the same groove as the camera back; the intention of this focussing glass, or screen, as it is sometimes called, is to ascertain the proper focus, as described more particularly at page 17. It will be found a very convenient plan to rule with a black lead pencil upon the focussing glass a number of square or oblong spaces corresponding to the position and size of the glass plates employed in the camera back, by which arrangement any required portion of a portrait or view can be brought into the space corresponding to that of the glass plate upon which the picture is to be taken: the importance of this coincidence must be sufficiently obvious.

The ground surface of the glass is generally arranged to be inside the camera when in its proper place. Attention should be paid to this, otherwise the distance of the ground surface upon which the picture is viewed and the focus adjusted from the lens, may not be the exact distance of the prepared surface of glass or paper contained in the camera back, when that is substituted for the ground glass frame: in which case, as the prepared surface would not be in the exact focus, a good photograph could not be obtained. In the best constructed instruments a small tablet, engraved "outside" is let in the frame of the focussing glass, to show the side that must be outwards from the camera.

Fig. 26. Fig. 27.



CAMERA BACKS.

The camera back is intended to hold the prepared plate or paper upon which a photographic impression is to be taken in the camera, and to prevent any access of light until required; it slides in a groove at the back of the camera. The two forms of camera backs, usually called the *single* and *double back*, are common to all the varieties of cameras described, therefore one description of their construction and use will suffice.

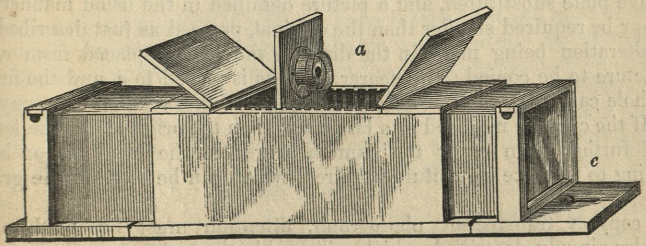
THE SINGLE BACK (fig. 26.) consists of a frame of wood with a sliding shutter in front (*i*), and a hinged back (*k*); when the back is opened, a projecting ledge of wood will be seen (*h*), upon which is laid the thin frame of wood having an oblong opening in the centre and fitted with a silver wire at each corner, represented at *m*. Upon these wires the prepared plate is to be placed, face downwards, and the hinged back closed and fastened. When the focus is adjusted on the ground glass, (taking care that the view or picture to be taken occupies the required position on the marked portion of the ground glass which corresponds to the prepared plate in the frame), the lens is closed up, the focussing glass removed, and the camera back substituted. The shutter in front being then lifted, exposes the sensitive surface of the plate to the action of the light whenever the cap of the lens is removed; when the action has continued sufficiently long, the cap is replaced, the shutter shut down, and then the frame and plate can be taken into the dark room for development and fixing.

THE DOUBLE BACK (fig. 27) is employed exclusively for sensitive paper; it consists of two frames hinged together at the bottom, and each having a mounted glass plate (*g*), inside and a moveable sliding shutter (*l*), outside. By this arrangement two pieces of prepared paper can be retained in a frame of no larger size than the ordinary single back, fitting the same sized groove at the back of the camera. When used, the glass plates should be nicely cleaned, and one of the pieces of sensitive paper

laid, face downwards, upon one of the plates of glass; a piece of bibulous paper, the size of the sensitive paper, is then laid upon it, and the other sheet of sensitive paper placed, face upwards, upon the bibulous paper: that portion of the frame and glass which is not occupied by the papers is now turned upon them, and secured in its position by two or more fastenings at the sides shown at (*n n*). By this arrangement, the papers are pressed perfectly flat against the two inner surfaces of the glass plates and at the same time the access of light is entirely prevented by the shutters in front. The shutters are numbered 1 and 2, as a guide which sheet of paper is to be exposed first, so as to prevent mistakes. When the slide is placed in the camera, after obtaining the focus, with the shutter No. 2 outside, the inner shutter is raised so as to obtain an impression in the usual manner; it is then shut down, and when another picture is to be taken, the slide is placed in the camera with the No. 1 shutter outside, and again the inner shutter raised; it need hardly be observed that it is essential to perfectly close the shutter that has been raised before removing the slide from the camera, and also to guard against the shutters accidentally opening while moving from place to place; this is easily prevented either by keeping the slide upright, tying a piece of string round it, or by a vulcanized India rubber band placed over the whole.

Where a small picture only is required on paper, the single back is usually employed, substituting two plates of glass instead of the wood frame with silver wire corners; between which pieces of glass the sheet of sensitive paper is placed.

Fig. 28.



COPYING CAMERA.

This form of camera is employed for copying photographs the same size or on an enlarged or diminished scale, and is also applicable for copying pictures, &c. The best lens to be employed with this apparatus is the copying lens described at page 9. The camera is represented by fig. 28, and consists of a centre box or portion (*a*), into which two end portions (*b* and *c*) slide. The top of the body lifts up, and a slide holding the lens is placed in one or other of the grooves cut in the sides of the box. The ends are

open and furnished with a groove for the purpose of holding either a dark frame or camera back, focussing glass and frame, or a frame having a series of openings corresponding to the usual size of photographic glasses. The usual method of construction, and one that will be found very convenient, is to make the grooves (*b* and *c*) suitable for the focussing and dark frame of the ordinary camera, in which case the only extra frame required for this camera is an open one for the negative. The principle of its action will easily be understood on reference to page 2, where the meaning of *conjugate foci* is explained. The method of use will depend upon the conditions required, whether the copy is to be of the same size, larger, or smaller than the original, and also the nature of the original, whether transparent or opaque. To make a copy of the same size as the original, that being on paper or other *opaque* substance, the slide holding the lens must be placed in one of the grooves near the middle of the camera (*a*). The picture to be copied is to be hung up in a good light, and the open end (*b*) placed exactly opposite to it, at a distance equal to twice the focal length of the lens, measuring from the lens to the picture; the focussing glass is then placed in the groove (*c*), and the body pulled out to such a distance, that the length from the focussing glass to the lens is the same as that from the lens to the picture. Then, by throwing over the head and end of the camera (*c*) a shade of some dark material, as black cloth or cotton velvet, in the usual manner of ascertaining the focus (page 17), the representation of the picture will be seen on the ground glass: the exact focus is obtained by sliding in or out the body (*c*). The body is now fixed by its set screw, the focussing glass removed, the dark frame containing the sensitive plate substituted, and a picture obtained in the usual manner. If the copy be required smaller than the original, proceed as just described, the only alteration being made in the distance the lens is placed from *c*, and the picture to be copied; the nearer the lens is placed to *c*, and the further the whole camera is removed from the original, the smaller the copy will be. If the copy be required of a larger size than the original, let the lens be placed further from *c*, or the camera nearer to the original, or both; according to the size of picture required, which can be seen on the ground glass.

To copy a transparent photograph, attention must be paid to the principles already described, which will enable the proper arrangements to be understood, so as to obtain the required size of copy, and the proper focus, the only thing requiring further explanation is the open frame, which fits the open end of the camera (*b*), as before stated, and which is employed to hold the glass picture to be copied. Having selected the proper sized frame, the glass picture is secured in its place by two small brass buttons, and the frame placed in the outer thick frame, which is then slid into the opening (*b*). The end of the camera (*b*) is now tilted, so that the light of a clear sky (not sunshine) can pass through the photograph; if this be found inconvenient, a sheet of white paper is placed slantwise a short

distance from the end (*b*,) so that a clear light is reflected through the camera. By viewing the representation of the object on the ground glass at *c*, the proper position of the paper reflector can readily be ascertained, as can also the proper focus. When these arrangements are completed, withdraw the focussing glass, and substitute the frame containing the prepared glass or paper upon which the copy is to be made.

ON OBTAINING THE FOCUS.

With the single achromatic lens, the focus is finally adjusted by rack-work, or by a simple sliding tube; but with the compound lenses, always the former. The focus is ascertained by either throwing a piece of dark calico or other material over the head and back of the camera, which, by shading the light, allows the picture to be seen on the ground glass: or, in a more correc manner, by using a short conical tube, having a magnifying glass at its upper end. The wide part of this instrument is placed on the surface of the ground glass, and the eye, being applied to the other end, perceives a magnified representation of any required portion of the picture, by which means a greater sharpness of outline is more easily and correctly obtained.

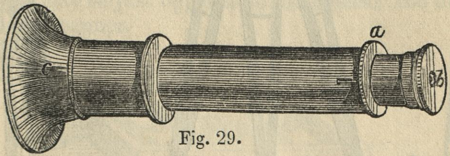


Fig. 29.

The focussing eye-piece (fig. 29,) is however the best and most convenient method of obtaining that extreme sharpness of outline so necessary for photographic pictures, and is employed in the following manner:—Adjust the eye-piece so that it shall exactly focus the roughness of the focussing glass. To do this, carefully note the side of the focussing glass that is outwards when the frame is in its position in the camera, and take the focussing frame in the right hand, so that this side shall be nearest you; then take the focussing eye-piece in the left hand, having previously unscrewed the clamping screw (*a*,) fix its broad end on the focussing glass, and observe if the roughness of the surface of the focussing glass appears sharp and defined to the eye looking into the eye-end (*b*.) If suchis not the case, shift the sliding tube up or down until the greatest amount of clearness is produced, and then tighten the clamping screw, so as to prevent any shifting taking place, and to insure the eye-piece remaining in perfect adjustment. To use it, the broad end (*c*) is placed on the ground focussing glass, and the lens or body of the camera shifted in or out until the greatest amount of sharpness of the picture is produced. At the suggestion of Mr. Horne, many persons use a focussing glass with a central polished spot about the size of a shilling, and having arranged the camera so that

the principal object shall occupy the required position, the base of the eye-piece is placed over the central polished spot, and the body of the camera or the lens is shifted in or out until the maximum amount of sharpness of the picture, when viewed through the eye-piece, is produced. This central polished spot is of great use where a focussing eye-piece is used, as the image being received on a polished surface, and there viewed by the eye-piece, the indistinctness caused by the irregular refraction of the ground glass is entirely obviated. But it must be borne in mind, that the image viewed through the central spot by the *naked eye* cannot be used to determine when the best focus is obtained, and that this central spot is only useful when the focussing eye-piece is used.

Fig. 30.

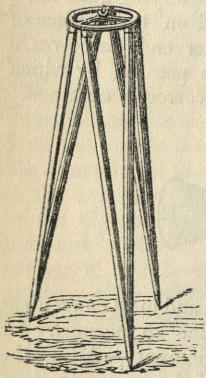


Fig. 31.

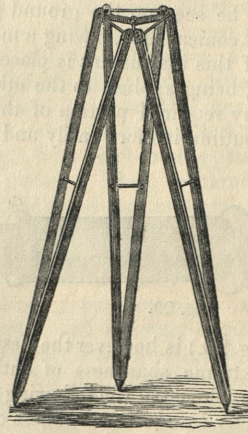
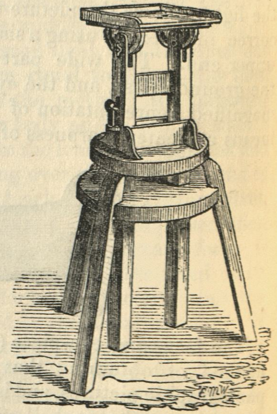


Fig. 32.



CAMERA STANDS.

For the purpose of directing the camera towards the object to be copied and keeping it steady during its employment, a variety of stands or supports have been contrived, the most convenient forms of which are represented above. Fig. 30 consists of three legs divided in the centre, the six tops being attached to a brass ring, through the centre of which is passed a screw, which being inserted into a brass plate at the bottom of the camera retains it in its place. When not in use, the legs come together and form three sticks about four or five feet long, rendering it convenient for portability.

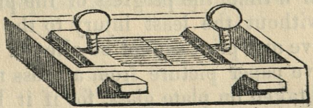
The form represented by fig. 31, is a very convenient one, extremely portable, steady, and well adapted for any kind or size of camera. The six portions of which the legs are composed fold together, so that the whole length is reduced sufficiently to pack, if required, in an ordinary portmanteau.

The tops of the legs when in use are attached to the metal triangle by their long screws. For some uses, the stand (fig. 32) is best adapted, from its firmness and facility of adjustment; the upper board upon which the camera is placed has a horizontal movement, and at the same time the horizontality or inclination of the camera is obtained by the two semi-circles under the top board; both these movements can be clamped when required by their respective screws. The height is regulated by lifting the two sliding square supports, at one side of which is a spring catch to prevent them falling; while the whole is firmly secured by turning a large wood screw in the centre of the stand.

REVERSING MIRROR.

As all objects in the camera appear reversed, that is, all right-hand objects appear on the left, and *vice versâ*, it is of consequence in some photographic processes, as that for positive pictures on glass by collodion, page 25, to obtain them as they appear in nature: this can be accomplished by employing a reflecting mirror placed in front of the lens, which has the effect of again reversing the picture in the camera and rendering the subsequent proof correct: when used, the camera is placed sideways, so that the mirror may be just opposite to the object; the focus is then adjusted in the usual manner.

Fig. 33.



REVERSING OR PRINTING FRAME.

This consists of a stout uniform piece of plate glass mounted in a wooden frame; the back of the frame is moveable, and consists of two pieces of wood, either separate or hinged: there is also a contrivance by which the back can be pressed against the plate glass either by wedges or screws. This apparatus is employed for obtaining positive from negative pictures. By a negative picture, is meant a picture in which the lights, shades, and position of objects comprising it are reversed to what they are in nature—this being due to the general action of light producing a darkening effect on a photographic surface, and also the relative positions being altered by the lens; consequently a light object is represented as a dark one, right hand objects become left, and *vice versâ*. It will also be obvious that if a photographic picture be taken from a negative one, a reversion will again take place, and a positive picture, or one correctly representing the natural object, will be produced.

To produce a positive photograph from a paper negative, proceed thus: remove the back board, clean the glass plate, and lay it in the frame;

then place the paper negative, face upwards, upon the glass, and lay a sheet of sensitive photographic paper, page 64, face downwards, upon the negative; now place over the back of the sensitive paper a piece of stout cloth or velvet about the size of the inside of the frame, put in the back boards, and tighten them up against the plate glass by means of the screws, by which arrangement the negative picture and sensitive paper are kept closely in contact. The frame is now turned so that the glass plate is upwards, and exposed to the action of light, either of the sun or the ordinary daylight, bearing in mind, that if sunlight is employed, care must be taken that no shadow of any object falls on the glass plate of the reversing frame. When the printing process is thought to be sufficiently done, which can partially be judged of by the depth of colour produced on that part of the sensitive paper not covered by the negative, the screws at the back of the frame are so far removed with respect to one portion of the back as to allow it to be taken away: then, by folding back the piece of cloth or velvet and that portion of the sensitive paper lying under it, the progress of the operation can be distinctly seen without deranging the relative positions of the sensitive paper and negative; if not found sufficiently printed, it can be returned to its original position, the portion of back board again returned to its place and screwed up as before, and the whole exposed again to the light until the desired result is obtained. It will be perceived from what has been described, that if care be taken only to loosen and remove one portion of the back at a time, the progress of the printing may be viewed as often as desired without the least injury to the result, as the relative positions of the negative and print cannot be altered.

To produce a positive paper picture from a glass negative, it is essential that the negative be taken on plate glass, for if it be taken on ordinary crown or window glass, which is never perfectly flat, it will inevitably be broken when a copy is attempted to be taken from it in the reversing frame. When there is no doubt of the negative being on plate glass, proceed as follows: perfectly clean the glass of the reversing frame from smears and dust, and also the plain side of the glass plate on which is the collodion negative, then lay it, collodion side upwards, in the centre of the glass of the reversing frame; now place over the collodion surface a sheet of sensitive paper (page 66), prepared side downwards: upon this, lay a piece of bibulous paper, and then a piece of cloth or velvet, put the two back boards in their places and apply a moderate pressure to them, so as to press the sensitive surface of the paper and the collodion surface of the negative into close contact. The frame is now exposed to the light, and the progress of the printing process observed in the same manner as described for printing from paper negatives. Full directions for printing positive pictures, with the method of preparation, fixing, &c., is given in the 65th, and following pages, on Positive Printing.

Fig. 34.

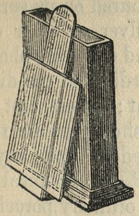
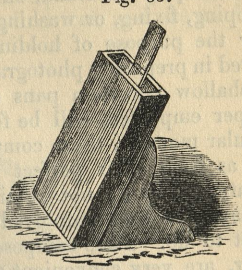


Fig. 35.



THE DIPPING BATH.

This apparatus is employed for immersing plates of glass in solutions of nitrate of silver and other chemical substances. The dipping bath is usually made of gutta percha, porcelain, or glass, and is mounted either upright, as fig. 34, or slantwise, as fig. 35. The dipper, which is used for holding the plate while being subjected to the action of the bath, is usually made of a piece of plate glass, to which the plate adheres by capillary attraction, and is prevented sliding off by a projecting portion at the bottom; a cover loosely fitting on the top of the bath will be found very convenient to keep off dust during the intervals of its use.

Fig. 36.

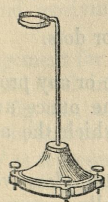
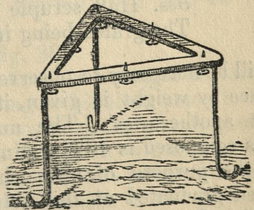


Fig. 37.



LEVELLING STAND.

For the purpose of keeping a glass plate perfectly level while developing or washing a picture, a levelling stand is employed, of the form of fig. 36 for small sized plates, or fig. 37 for large ones. Its use is very simple—the utility of the screws being to bring any plate laid on the top to a perfect level; this is ascertained by pouring water on its surface—a considerable quantity will remain there if it is level, or if not, it will flow off where lowest, indicating that the screw near that point is to be raised; it will be obvious, that if once adjusted with one glass plate and not disturbed, any other plate when laid

upon the top of the stand, on the same screws, will be level, and retain any developing, fixing, or washing fluid that may be poured on its surface.

For the purpose of holding any solution of silver or other chemicals required in preparing photographic paper, fixing, and colouring photographs, &c., shallow porcelain pans of various sizes, according to the dimensions of paper employed, will be found most convenient; where cost is of no particular moment, those composed wholly of polished glass are very advisable, as from their perfect smoothness, and freedom from any absorbent nature, they do not retain the least trace of any chemical solution that may have been employed in them, which the ordinary porcelain pans are apt to do. Pans composed of gutta percha, and fitting within one another, are very convenient and portable, and particularly applicable for washing positive photographs after printing, when a considerable quantity of water is required.

For weighing out quantities of chemicals, &c., a pair of scales must be employed, the pans of which should be of glass, which is not acted upon by nitrate of silver, and a set of brass weights. These weights are usually similar to those used by apothecaries, and are sufficiently near for photographic purposes; they are indicated by the following signs stamped on them:

ʒij.	Two drams	equal to	120	grains,
ʒj.	One dram	„	60	„
ʒss.	Half a dram	„	30	„
℈ij.	Two scruples	„	40	„
℈j.	One scruple	„	20	„
℈ss.	Half scruple	„	10	„

The grains being indicated by numbers or dots.

It will be necessary to observe, that where an ounce or any proportion of an ounce by weight is given, it generally refers to the ounce avoirdupois, and not apothecaries'. The number of grains of which the avoirdupois ounce is composed is $437\frac{1}{2}$ grains.

For the purpose of measuring quantities of liquid, glass vessels are employed graduated at the side. The most generally convenient sizes will be found, one holding about two ounces, and one smaller, graduated into drops or minims as they are termed. One minim or measured drop being about equal to two drops from a glass rod or bottle. The mark ℥ signifies ounce, of which twenty go to the pint; ʒ means dram, of which eight go to the ounce; ♏ graduated on the smaller measures indicates minim or drops of which sixty make up the dram.

Care should be taken that the measures are perfectly smooth at the bottom, so as to be perfectly cleaned out each time of using. When a quantity of liquid is to be measured, the measure is held up about level with the eye, by which the level of the liquid and the proper quantity is easily observed.

A few glass rods about 9 inches long are often required for photographic purposes, they should be perfectly smooth and cylindrical, and are used for

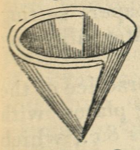
Fig. 38.

the purpose of mixing and applying various solutions; a glass flask or two for making and heating solutions: a few glass funnels and conical-lipped glasses of various sizes, for filtering solutions of silver, hypo-sulphite of soda, &c., and receiving the solutions when filtered, will also be found useful.

The arrangement for filtering is shown at fig. 38.

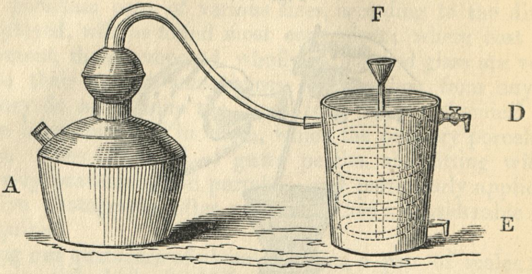
A funnel and receiving glass of the required sizes are arranged as shown in fig. 38.; a circular piece of filtering or bibulous paper is folded in half twice, so as to form, when opened, a kind of paper cone, as represented at fiig. 39; this is placed within the funnel, and the solution to be filtered, supposed to be in a flask, is poured in a gentle stream against the doubled side of the paper cone; this is best and most neatly performed by applying a moistened glass rod to the edge of the vessel from which the fluid is to be poured, and placing the end of it so that a slight inclination of the flask or other vessel will cause a slender stream to flow down the rod against the side of the paper cone without the danger of breaking the paper, or spilling the fluid. For the purpose of making the various solutions, distilled water should alone be used, and care must be taken not to employ distilled water containing the smallest quantity of any organic substances, such as essential oils, &c., which would speedily cause solutions of silver—solutions chiefly used for photographic purposes—to become decomposed and useless. Where pure distilled water cannot be obtained, the requisite

Fig 39.



quantity can very easily be manufactured by means of a portable still, represented by the accompanying cut.

Fig. 40.



The body (A) contains about a gallon of water, to be introduced through the opening, which is afterwards closed with a cork:—it is then placed over a gentle fire, and the worm-tub, placed on a convenient support, connected with it by means of an intermediate tube, the joints being rendered steam-tight by two short pieces of vulcanized India-rubber tube. The worm-tub being filled with cold water, condenses the steam as produced, and the distilled water runs off at the opening (E). As the water becomes hot it is drawn off by the stop-cock (D), a fresh quantity of cold water being poured into the funnel (F), which reaches to the bottom of the tub. Very pure water, and quite equal to distilled, can be obtained by melting a clean and clear piece of ice, the Wenham Lake ice being the best for the purpose.

The best substitute for pure water, and what is quite equal to it for many of the processes where a considerable quantity is required, as in washing out the salts of silver, &c., in preparing iodized paper, setting paper positives, &c., is made by boiling rain or soft river water, allowing it to cool, and then carefully filtering it.

There are other convenient contrivances for facilitating the practice of the various branches of photography, such as holders for preparing plates with collodion, and also for polishing plates, head rests, plate boxes &c., which will be found described in the photographic catalogue; and the use of which will be sufficiently obvious, and not require further notice than that made under any specific process in which they may be employed.

COLLODION POSITIVES ON GLASS.

BY WILLIAM ACKLAND.

Before entering into the manipulation for the production of positives on glass, it is necessary that the amateur should possess a clear idea of the meaning of the terms "positive" and "negative."

A positive collodion picture may be defined to be a photograph giving a natural representation of the object it is intended to represent when viewed by reflected light.

A negative picture, on the contrary, when viewed by reflected light, gives but an imperfect representation of the object from which it was taken, having the high lights of the picture obscure and of a brown colour, without any apparent definition of middle tints, or the light and shades merging into one another with abruptness, but, if viewed by transmitted light, the lights and shades are reversed—representing all the pure whites of the object by perfect blackness, the blacks by perfect transparency, and the middle tints of various gradations of tone in the same *inverse* order, according as the parts represented are more or less approaching the white or sombre shades.

The production of positive pictures has of late been much followed, both by amateurs and professional photographers, from the ease and rapidity of their production, the delicacy of the detail, and the brilliancy of the resulting picture, which rivals daguerreotypes in the representation of minutiæ; although, unlike the daguerreotype, it may be viewed in any light. The apparatus necessary for the production of positive pictures is not essentially extensive, consisting of a camera, lens,* camera stand, glass or gutta percha bath and dipper, glass plates, and box to contain them, graduated measure, funnel, filtering paper, scales and weights, washing tray, levelling stand, pocket level, stirring rod; and, of chemicals, a supply of positive collodion with a proportionate quantity of iodizing solution, nitrate of silver, acetic acid, protosulphate of iron, nitrate of barytes, cyanide of potassium, crystal varnish, black varnish, and distilled water, together with a small quantity of nitric acid, ammonia, and tripoli.

Before entering into the description of the manner of taking photographs, a few words on the manufacture of gun cotton and collodion will be necessary.

The preparation of gun cotton and collodion are operations that few amateurs would venture on, as they require considerable care and attention to insure success; still, circumstances may occur in which a knowledge of the mode of manipulation may be useful.

* Prior to the purchase of apparatus, the amateur, should read the remarks commencing at page 7, so as to select the camera and lens best adapted for his purpose.

TO MAKE GUN COTTON.

Take four ounces of nitrate of potash, powdered and thoroughly dry, and place it in a porcelain capsule holding about one pint, then pour over it five ounces, by measure, of the ordinary commercial sulphuric acid (sp. gr. 1·840), stir well together with a glass rod, and then immerse, in small portions at a time, two drams of fine cotton wool, previously dried; continue the stirring with the glass rod, so that every portion of the cotton becomes thoroughly impregnated with the acid mixture. Occasionally press down any portion of cotton which may rise above the liquid, and, when ten minutes have elapsed, remove the cotton by the aid of two glass rods into a large vessel of water; stir briskly, and repeatedly change the water, wringing the cotton as dry as possible between each change, until every trace of acid is removed. Then, as a still further precaution to the perfect removal of the last traces of the acid, wash the cotton with two or three washings of boiling water; then wring dry; pull out the fibres, and dry it thoroughly by a very gentle heat, always bearing in mind that this substance is more or less explosive, and, therefore, must not be brought too near a candle or fire. When perfectly dry it may be preserved for any length of time if kept in a closely stoppered bottle.

Should the gun cotton have been correctly prepared, it will completely dissolve in rectified ether, forming a clear solution, which, when poured on a glass plate and the excess drained off, dries perfectly transparent, free from specks or milkiness of the film.

PREPARATION OF COLLODION.

Put one ounce and a half of rectified ether (sp. gr. ·750) in a two-ounce stoppered bottle, add to it ten grains of gun cotton, and agitate frequently to facilitate the solution. If the gun cotton is good, it will dissolve in a few minutes, and, in the generality of cases, produces a collodion of the necessary amount of thickness, but the proportion may be varied until the desired viscidity is obtained.

Collodion of the proper thickness, when iodized and poured on a glass plate and then drained off, as described under the head "Coating the Plate," should dry to an even transparent film, free from ridges, and flowing easily over the plate, without an excessive tendency to run off.

A sufficient quantity of this collodion may be made to last for months, and, by being allowed to stand undisturbed, any particles of undissolved cotton will sink to the bottom of the bottle, allowing the upper portion to be decanted off perfectly clear.

The collodion thus made has to be iodized to render it fit for photographic purposes. Various formulæ are published for the manufacture of

the iodizing compound, but the writer has found none succeed so well, in the hands of the unprofessional, as a mixture of the following solution :—

Take	Iodine . . . . . . , .	4 grains.
	Alcohol	1 ounce.

Dissolve, and label the bottle containing this solution, "Solution of Iodine."

Now, for the iodizing mixture, take—

Iodide of potassium	12 grains.
Solution of iodine	4 drops.
Alcohol	1 ounce.

Add the iodide of potassium to the alcohol, and shake frequently until dissolved, then add the solution of iodine, filter through filtering paper, and preserve in a closely stoppered bottle labelled "Iodizing Mixture." This solution will keep good any length of time.

In order to iodize collodion with this mixture, all that is needed is to add half an ounce of the iodizing mixture to one and a half ounce of collodion, and, after shaking well together, allowing the bottle containing it to remain undisturbed for at least twelve hours, in order that any insoluble matter may settle to the bottom; and, before being used, it is advisable to pour off the clear portion of the iodized collodion into a clean and perfectly dry bottle.

As collodion, when iodized as above stated, does not keep good more than three weeks, it is advisable not to iodize more than will be used in a fortnight, the best pictures are taken with collodion that has been iodized from two to ten days, after which time it begins to lose its sensibility and ultimately becomes useless, from the length of exposure necessary to obtain a picture. The amateur can hardly be expected to put these remarks into practice, as positive collodion and iodizing compound may be purchased at Messrs. Horne and Thornthwaite's,* as can also negative collodion and its iodizing compound. Still, in foreign countries, where great loss of time would result in sending to England, the knowledge of the necessary manipulation may be useful, and a perusal of the hints here given will not be thrown away if the amateur iodizes collodion for himself.

The production of positive pictures may be divided into nine distinct heads :—

1. Cleaning the plate.
2. Coating the plate.
3. Exciting the plate.
4. Arrangement of the sitter.
5. Focussing.
6. Exposure in the camera.
7. Development of image.
8. Fixing.
9. Finishing the positive picture.

* See page 73.

1. CLEANING THE PLATE.

The glass best adapted for receiving positive pictures is termed "patent plate;" this can be obtained ready cut, and the edges ground to prevent injury to the fingers, of the usual sizes required by photographers.

The size of picture produced is, to a great extent, governed by the size and focal length of the lenses employed. If a one inch and three-quarters portrait lens (No. 1075) is to be used, plates four inches by three inches may be chosen; if a two inches and three-eighths portrait lens (No. 1073), five inches by four inches; and if a three and a-quarter inch portrait lens (No. 1071), six inches by five inches.

The best substance for removing stains, grease, &c., from glass plates is a mixture, made as follows:—

Cyanide of potassium . . .	2 drams.
Tripoli	2 drams.
Water	2 ounces.

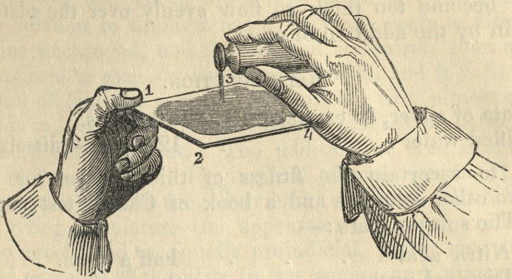
Dissolve the cyanide of potassium in the water, then add the tripoli, and shake well together.

Having selected a suitably sized glass plate, pour a tea spoonful of this mixture over the centre of the plate, and, with a pledget of linen, well rub it over every part, back and front; hold it under a tap to rinse, or dip it in a basin of cold water, so as to remove every particle of the mixture; then, without waiting for the plate to dry, remove every trace of moisture with a linen cloth, and polish with another linen cloth, holding the plate by the cloth, and not by the hand, so as to prevent the slightest grease being communicated to it.

The cloths employed should be of a material sold as "fine diaper," and must be well freed from grease or soap, by careful washing in soda and water, then plentifully rinsed in water and dried; also the one used as a polisher should be kept quite dry. Occasional breathing on the plate during the polishing and then holding it obliquely, so that the moisture deposited may be seen by reflected light, will serve to point out whether a plate is clean or not. If the moisture of the breath is deposited in patches, more cleaning is required; but if the deposit is evenly spread over the whole surface, it may safely be considered as clean; but too much care cannot be bestowed on this part of the process, for the slightest impurity, although now apparently invisible, renders itself palpable in the after processes, to the complete destruction of the finer details of the finished picture.

Glass plates, after being once used, require a more careful cleaning than new plates, before being again employed, and as the film is easier detached whilst still moist, it is advisable not to allow them to dry, but to place all plates that are to be used again in a vessel of water before they become dry, and allow them to remain immersed until required for cleaning.

Fig. 41.



2. COATING THE PLATE.

Before proceeding to coat the plate, it is necessary that the collodion should have been mixed with the iodizing solution at least twelve hours, and allowed to remain undisturbed, so that any sediment which forms may have subsided; and, in all cases, the dust and dried crust of the collodion, which may adhere to the neck of the bottle must be carefully removed, otherwise spots and striæ will be produced on the plate.

If particles of dust are floating in the air of the operating room, it will be useless to attempt to coat a plate, as these will deposit themselves on it and appear as fine filaments, which serve as a nucleus for a spreading stain in the after process. For this reason it is recommended to clean the plates in another room, so as not to disturb the atmosphere of the operating room by this operation.

Now ascertain that the glass plate is scrupulously clean and free from finger marks; remove any adherent particles of dust by friction, with a chamois leather. Hold the plate horizontally by the corner No. 1, (fig. 41), with the finger and thumb of the left hand, remove the stopper from the iodized collodion bottle, and, holding it in the right hand, pour the collodion on to the glass plate in sufficient quantity to form a circular pool extending nearly to the corners. Now incline the plate so that the fluid may flow to corner 3, then to corner 4, then to corner 1 (avoiding the thumb if possible); and drain off the superfluous collodion back into the bottle, by the corner 2, holding the plate in a vertical direction. Give the plate a rocking motion on the neck of the bottle, by raising and depressing corner No. 1, so that the lines or furrows which are formed may run one into the other; continue this until the covered surface of the plate appears set from the evaporation of the ether; when this takes place, the plate is ready to be rendered sensitive.

As the vapour of ether is highly volatile and inflammable, great care must be used in not approaching a light near an open bottle of this fluid or of collodion, as serious accidents may occur from any negligence in this particular.

Should the iodized collodion, from the evaporation of its volatile constituent, become too thick to flow evenly over the plate, it may be rendered thin by the addition of ether.

BATH SOLUTION.

Nitrate of silver, in crystals .	6 drams.
Distilled water	12 ounces—dissolve and filter.

In order to ascertain the fitness of this solution for photographic purposes, two other solutions and a book of Clark's test paper* will be required. The solutions are:—

1st.	Nitric acid . . .	half a dram.
	Distilled water . . .	2 ounces — mix, and label "Dilute nitric acid."
2nd.	Ammonia . . .	half a dram.
	Distilled water . .	2 ounces — mix, and label "Dilute ammonia."

In order that the "Bath solution" may be in a condition to give good pictures, it must contain a *slight trace of free acid*, and it frequently happens that the nitrate of silver employed contains just the required quantity; but occasionally it contains none, and sometimes an excess. Therefore it becomes evident we cannot depend on always making our solution contain just the amount required and no more. We, therefore, take a leaf of test paper and apply a drop of the bath solution to its coloured surface. If the violet colour of the test paper remains unchanged after the solution has been applied one minute, the solution contains no free acid, and in chemical language is said to be "neutral."

Add one drop of dilute nitric acid to each six ounces of bath solution, shake well together, and apply another drop to the test paper. If the solution was exactly neutral in the first instance, the colour of the paper will now be changed to a pale red, and the bath may be considered fit for use; but should the paper, when the solution is applied, not change to a pale red, add another drop of dilute nitric acid to each six ounces until the desired tint is produced.

Should the test paper, when first moistened, change to a bright red, the bath solution is too acid, to neutralize which, add dilute ammonia, drop by drop, shaking well between each addition, and testing with test paper until the colour of the paper is unchanged after the solution has been in contact with it one minute; when such is the case, add one drop of dilute nitric acid to each six ounces of solution, shake well together, and it is fit for use.

* The ordinary test paper is not of sufficient delicacy for testing the bath solution. Horne and Thornthwaite prepare Clark's test paper expressly for this purpose. It is sold in small books of twenty leaves, enclosed in a bottle, price 6d. each, which must be kept closely corked to prevent the atmosphere injuring it.

Should the test paper turn blue after being wetted, too much ammonia has been employed, and dilute nitric acid must be added, drop by drop, applying the solution to the test paper between each addition, until the colour remains unchanged, and the solution is neutral, then add one drop of dilute nitric acid to each six ounces of solution, and it is fit for use.

This amount of free acid is ample for working with almost every kind of collodion; but in some cases, where extreme rapidity of action is required, half this quantity is sufficient. The addition of free acid to the bath solution is added to prevent "fogging" of pictures produced by it, which is caused by a reduction of the silver on those parts which constitute the deep shade, giving the picture the appearance of being veiled by a dense fog; but too much acid is equally prejudicial, giving rise to a necessity for prolonged exposure of the plate in the camera, and often to an irregular action of the developing fluid.

It is necessary to test the bath with test paper after the immersion of each 30 or 40 plates, in order to ascertain if it contains the necessary amount of free acid, and should it be found either in excess or too little, it must be remedied as above described. This testing must, in no case, be done hurriedly, but a drop must be applied to the test paper, and allowed to remain in contact one minute, then shaken off, and the colour of the wetted part noticed; and I must caution the amateur not to look for excessive changes of colour by the application to the test paper, for if the slightest increase of blueness in the wetted part is obtained, the solution is alkaline, and if a change *towards redness*, the solution is sufficiently acid, as a bright red indicates an excess.

It frequently happens that after the bath solution has been in use for some weeks or months, and has always worked well, it will suddenly change, and produce "foggy" pictures, although the test paper shews it to contain the proper amount of acid. This sudden change has sorely puzzled many able photographers; but Mr. Horne has clearly shown that it arises from the *supersaturation* of the solution with iodide of silver,* aided by the evaporation of the solution which ensues in hot weather. To remedy this defect, add two ounces of distilled water to each pint of the bath solution, and filter, to remove the turbidness which ensues, then add one dram of nitrate of silver, and when it is thoroughly dissolved, filter again, to ensure the solution being perfectly clear.

* Iodide of silver is formed on the immersion of a plate, covered with iodized collodion, into the bath solution, giving rise to the yellow tint produced on the plate. This iodide of silver is partially soluble in the bath solution, which becomes, by long use, fully saturated and in this condition is useless. The addition of the distilled water causes the iodide of silver to precipitate, and the nitrate of silver is added to bring the solution to its proper strength.

The bath solution after being in use some time becomes slightly weaker; the original strength may be restored by a small portion of nitrate of silver being added.

TO EXCITE THE PLATE.

The plate, after being coated with iodized collodion, drained, and the ether allowed to evaporate, is ready to be excited; the time required for the ether to evaporate, and the film to "set," depends on the fluidity of the collodion, and also on the temperature. Until the amateur can judge from the appearance of the plate he should allow ten seconds to intervene between the ultimate draining and its immersion in the bath. If the plate is immersed too soon, transparent cracks will form in the film, on its lower edge, and if too much time intervenes, the film dries in parts, and developes unevenly.

Coating the plate is best effected with the aid of a good light, but all after operations must take place in a room from which every particle of white light is excluded; this is easily effected by covering up the windows of the operating room with three thicknesses of "yellow glazed calico," as light, after passing through this and other yellow mediums, although yielding sufficient illumination to serve our purpose, does not in the slightest degree have any chemical effect on the sensitive surface of the plate, whereas the slightest gleam of white light would cause it to whiten all over on applying the developing solution.

The bath, having been previously filled with bath solution, to within three-quarters of an inch of the top, and placed in the operating room, the plate, still held by one corner, is now laid, collodion side uppermost, so that it is in contact with the projecting slip on the glass dipper, and the dipper and plate is lowered into the bath with one steady motion, as any pause will cause a corresponding mark or line to develope itself on the picture in its after treatment.

The plate is now allowed to remain undisturbed in the bath for one minute, and is then to be partially drawn out of the fluid three or four times, and again immersed, until the greasy appearance of the surface, caused by the remaining ether of the collodion, is removed, and the solution flows off in one uniform sheet.

Two minutes' immersion in the bath is ample in warm weather, but from three to five minutes is required in winter.

The plate, having completely lost all appearance of greasiness on its collodion surface, is then removed from the dipper, by the finger and thumb applied to one corner, and allowed to drain, by being stood up nearly vertical on filtering paper, in a dark corner of the operating room, where no white light can reach it, for ten seconds, to remove any excess of the bath solution; the solution adhering to the back of the plate is then removed by wiping, (taking care not to touch the collodion side), and the plate is ready to be placed in the camera back.

The camera back is furnished with two flaps, one sliding in a groove, and the other opening, as a door, on hinges. All dust having been previously

removed, the sliding flap is pushed down in its place, and the hinged flap opened; a plate-holder with silver wire corners, having an aperture adapted to the size of the plate, is laid into the camera back, so that the silver wire is next the sliding flap. The excited collodion plate is taken up from its position, where it was stood to drain, by being grasped by the thumb and fore-finger of the right hand, one to either of the longest sides; the camera back is held horizontal in the left hand, and the plate inserted, so that its four corners may rest on the wires, *and that its collodion side may be next the sliding flap*; the hinged flap is now shut down, and secured from coming open by the brass button being turned over it; in this state, the back containing the plate, may be taken out of the operating room without the possibility of light coming in contact with it, and it is now ready for exposure in the camera; but, previous to doing this, we must digress a little, and say a few words on the arrangement of the sitter, and on focussing.

ARRANGEMENT OF THE SITTER AND EXPOSURE IN THE CAMERA.

The sitter must be placed so that the figure is well illuminated, with one side of the face *slightly* in shade, and looking towards the north, if possible; two or three feet behind, a "back-ground" must be set up composed of a blanket stretched over a frame, or, if this cannot be procured, hung, so as to be free from folds, over a large clothes-horse; a dark back-ground must be used where the sitter has very light or grey hair; the hands and knees of the sitter must be so arranged as to be at about the same distance as the face from the camera, to prevent those parts being out of focus or distorted by the lens.

The sitter should assume an easy, natural position, free from constraint or a fixed look, and should, if possible, divest himself of the idea that his portrait is about to be taken, assuming, in look and position, an unstudied and natural appearance.

In general the full face makes but indifferent portraits; the most pleasing are with the head slightly turned on one side, termed three-quarter face, and the eye should be fixed steadily on some dark object.

The camera has now to be fixed on the camera stand, by means of the fixing screw, and placed in front of, and about four to eight feet from, the sitter, bearing in mind that the nearer the camera is placed to the sitter, the larger will be the image produced, and *vice versâ*, so that if a small image is required, the distance between the camera and the sitter must be increased until the required size is obtained.

In order to be enabled to view the image of the sitter, which is formed on the ground glass when the cap of the lens is removed, a black linen or velvet cloth (termed a focussing cloth) is thrown over the back of the camera and head of the operator, so as to exclude all light except that which passes through the lens. By this means a brilliant inverted image

of the sitter should be visible on the roughened surface of the focussing glass. If such is not the case, the sliding portion of the camera (if of the expanding form) is drawn out, until the image is nearly distinct; the rack and pinion head of the lens is now turned so as to move the lens in or out of the camera until the greatest possible sharpness of the image is obtained.

When this is the case, the cap is placed on the lens, the focussing screen removed from the camera, and the camera slide, containing the moist and sensitive collodion plate, is put into its place, taking especial care that the sliding shutter is towards the lens—a hint from the operator is necessary to ensure the sitter keeping perfectly steady. The sliding shutter is now gently drawn up to its full extent; and when the vibration given to the camera by this action has ceased, the cap of the lens is removed, and the time of exposure noted by a seconds' watch. When the necessary amount of exposure has been given, the cap of the lens is replaced; the sliding shutter pushed down, and the camera slide removed from the camera and carried again into the dark room, there to receive the necessary application of a solution, to cause the development of the impressed but quite invisible image: before, however, going into the necessary details of the development, we must say a few words on the time of exposure necessary.

The time of exposure necessary to impress the latent image on the plate is dependent on so many varying influences, that it is impossible to lay down any exact rule for the guidance of the amateur. The focal length and aperture of the lens—the intensity of the light—the state of the collodion —and the amount of free acid in the bath, all act either together or singly to produce the most variable times of exposure, from two or three seconds to one minute; but, supposing the light to be of the ordinary intensity of a bright autumn day without direct sunshine on the sitter, the collodion iodized about twelve hours previously, and the bath but faintly acid, the time of exposure, with a portrait lens of four inch focus, the lenses of which have a clear aperture of one and five-eighths inch, will be about ten seconds; with a portrait lens of six inch focus, and two inches and three-eighths aperture, the exposure must be about nine seconds. whilst with a portrait combination of ten inch focus and three and a quarter inch aperture, the time of exposure will be about twelve seconds. If the sun is shining with the full vigour of summer, although the sitter is in the shade, the time may be reduced at least one half; but the amateur is cautioned not to attempt the taking of instantaneous pictures, but to strive so to modify the light by screens, &c., that the exposure necessary may be about what is quoted above, as he may then expect to see the resultant pictures with a good contrast of lights and shades, and the middle tints clearly defined, whereas pictures taken with a less time of exposure generally possess the lights and shades well marked, but quite a deficiency of the middle tints; and as it is to these we look for softness and finish in the picture produced, we must cultivate their production to the greatest extent in our power.

TO DEVELOPE THE LATENT IMAGE.

Protosulphate of iron	2 drams.
Nitrate of barytes	$1\frac{1}{2}$ dram.
Glacial acetic acid	2 drams.
Alcohol	3 drams.
Rain, or distilled water . . .	10 ounces.

Dissolve the two drams of protosulphate of iron in five ounces of water, to which add the two drams of acetic acid, and the three drams of alcohol; dissolve the one and a half dram of nitrate of barytes in five ounces of water; the crystals being completely dissolved, mix the two solutions together, when a dense white precipitate is formed, which, floating in the mixed solution, gives rise to an appearance of milkiness; allow the whole to remain undisturbed for two or three hours, during which time the precipitate will subside, and the upper clear fluid may be poured off, and filtered through filtering paper for use.

This solution will keep good for a month, although it becomes a reddish colour after being made a few days.

The camera slide containing the plate having been removed into the dark room, the plate is withdrawn from the slide, and placed, with the collodion side upwards, on a fixing stand, which must be previously made quite level, and then quickly covered with the developing solution,* which must be poured rapidly over the plate, so that the whole surface is completely covered.

Gently blow on the plate, so as to keep up a disturbance of the developing fluid, until the prominent whites of the picture are just visible, which, under ordinary circumstances *with the above developing solution*, takes at least half a minute. The plate is now taken up by the finger and thumb of the left hand, and the developing solution poured off, and then on again, five or six times, or until the middle shades of the picture are visible, although it must be remembered that the fainter shades are, at this stage, partially obscured by the iodide of silver.

When these shades show themselves, pour off all the developing fluid, replace the plate on the fixing stand, and pour gently over it at least half a pint of water, as it is necessary to remove every trace of the developing fluid. The plate is now ready for the next process, termed "fixing the image."

FIXING THE IMAGE.

This part of the process is for the purpose of removing from the plate the unaltered iodide of silver, which if allowed to remain, would be liable to alter by exposure to light, and much obscure the details of the picture.

* The quantity of solution necessary to cover a plate five inches by four inches is three drams.

FIXING SOLUTION.

Cyanide of potassium	1 scruple.
Water (rain or filtered), ...	8 ounces.

Dissolve the cyanide of potassium in the water and keep closely stoppered for use.

The plate, having been thoroughly washed so as to remove every trace of the developing fluid, is placed on the fixing stand, and a sufficiency of the fixing solution poured on to cover it; this is allowed to remain on until the yellow opalescent colour of the film disappears, which takes place in from one to two minutes, and in order to facilitate the operation, the plate may be gently blown on so as to keep the solution agitated.

When the yellow colour disappears, the plate may be tilted and a stream of water gently poured on, so as to remove every trace of the fixing solution, which if allowed to remain would cause the picture, sooner or later, to disappear; when the operator is satisfied that none of this solution remains, the plate may be drained and then dried, either over a spirit lamp or before a fire, and is then ready to receive the last operation of "varnishing" and "backing up," termed:—

FINISHING THE POSITIVE PICTURE.

The plate having been thoroughly dried and made moderately warm over a spirit lamp or near a fire, is taken between the finger and thumb of the left hand and crystal varnish* poured over the collodion side, and this drained off exactly in the same manner as described for the application of the iodized collodion, so that a thin uniform stratum may remain; after being drained, the plate has again to be warmed, so as to facilitate the drying of the varnish and to prevent its becoming milky instead of transparent. When this coating is thoroughly dry the plate has again to be warmed, and a coating of BLACK JET* poured over its uncovered surface *(not on the collodion side)*, and this drained off and stood up on its edge to dry, which will take from two to twenty-four hours. When the black varnish is thoroughly dry, the picture is ready to be mounted, either in a morocco case or morocco frame, in which case, the collodion side being upwards, requires to be protected by an outer covering of glass, which is prevented from resting on the picture by the interposition of a gilt mat with an appropriate opening to suit the picture; or the picture may be mounted in a passe partout, when no extra glass is required, as in this case, the glass of the passe partout serves instead. The picture is inserted by making an opening at the back.

The only objection to this plan of finishing is, that the sides of the portrait are reversed—that is, a blemish on the right cheek appears as though it were on the left. If this is considered objectionable, the black varnish may be applied *on the collodion side*, after the application of the crystal varnish, but not until the plate has become quite cold, as if applied when the plate

* See page 73.

is warm, the black varnish is very liable to permeate the crystal varnish and give a brown tone to the whites of the picture.

The appearance of the picture when finished serves to indicate whether the bath is in good condition, and whether the proper time of exposure was given in the camera.

If the features present a dull, heavy appearance, without any, or but few of the middle tints or dark shades of the drapery showing themselves, the cause is either a too acid bath, or from the use of collodion that has been too long iodized, or too short an exposure in the camera. The plan for correcting a too acid bath will be found at page 30. If the dark shades of the pictures show themselves with too much effect, being nearly as visible and prominent as the high lights, and the whole has an appearance as though seen through an opaque film, termed "fogging," it arises from one of the following causes:—

The absence of acid in the bath;

Over exposure in the camera;

An admission of white light to the plate after being excited; or,

A too long application of the developing fluid.

As over exposure in the camera is most likely to give rise to this defect termed "fogging," it is recommended to prepare another plate and give it only one half the exposure. Should this prove ineffective, and the defect still exist as prominent as before, it must be remedied by guarding against the other causes which may give rise to it. The time necessary to expose a plate in the camera, to produce the maximum effect of brilliancy in the picture, is one requiring some degree of tact and knowledge, so as to suit the time to the ever-changing intensity of light; but the process here detailed admits of considerable deviation from the correct time of exposure, so that the amateur need have no fear about his ultimate success, after perhaps, a few failures; as if *over exposed*, the picture developes rapidly; whilst, if *under exposed*, the action of the developing fluid being slow and but little liable to overdevelope on the high lights, admits a continued application until the middle tints are also visible.

THE COLLODION PROCESS FOR NEGATIVES.

NEGATIVE COLLODION.

This preparation is made in the following manner:—Half an ounce of dried nitrate of potass in fine powder is to be mixed with three-fourths of an ounce of ordinary strong sulphuric acid, of sp. gravity about 1·850, in a porcelain capsule, with a glass rod, and half a dram of clean dry cotton is then added as quickly as possible, and stirred about in the mixture for about five minutes; when removed, it is to be carefully and thoroughly washed with water, and dried by exposure to a warm atmosphere. Ten grains of the gun cotton thus obtained are dissolved in half an ounce of sulphuric ether, to which is added one dram of alcohol. Five grains of iodide of potassium or of iodide of ammonium are now dissolved in the smallest quantity of alcohol, and added to the collodion, together with about three ounces of sulphuric ether, so as to enable it freely to flow over a glass plate.

A few grains of iodide of silver dissolved in the iodide of potassium increase its sensibility, in which case the preparation must not be used until it has become clear, by allowing the superfluous iodide to settle, or a multitude of black specks will be formed on the plate.

There are six operations in obtaining a negative collodion picture, viz:—cleaning, coating and exciting the plate, reception and development of image, and finally, fixing and preserving the same from injury.

CLEANING THE PLATE.

This is done with the same care and by the same means as described at page 28 for collodion positives.

COATING THE PLATE.

The method fully described at page 29 for positive collodion must be followed, of course using the negative collodion for the purpose, of which the method of making is described above, or it can be purchased ready made of Messrs. Horne and Thornthwaite.*

EXCITING THE PLATE, AND EXPOSURE IN THE CAMERA.

For this purpose is required a dipping trough, described at page 21, which is to be filled with a solution of nitrate of silver, or bath composed as follows:—

Nitrate of silver in crystals . . .	6 drams,
Iodide of potassium	3 grains,
Distilled water	12 ounces,
Alcohol	2 drams.

* See page 73.

Dissolve the six drams of nitrate of silver in one ounce and a half of the distilled water, and the three grains of iodide of potassium in one dram of distilled water; mix the two solutions and shake well together until the precipitate, which is first thrown down, is redissolved; when this takes place, add the remaining ten ounces and a half of distilled water and the two drams of alcohol. On the addition of the water a turbidness ensues, which must be removed by the solution being very carefully filtered through filtering paper; and the filtered liquid should be clear and transparent, free from any deposit or floating particles.

In order to ascertain if the solution, thus prepared, possess the necessary amount of free acid without superabundance, moisten a fragment of Clark's test paper with a drop of the solution, and observe the effect of this application on the colour of the paper.* If the colour remains unchanged the solution is neutral, if it turns blue it is alkaline, and in either case would produce hazy pictures (termed "fogging"). To remedy this defect, add acetic acid, diluted with ten times its bulk of water, drop by drop, until the solution when applied to the litmus paper changes its violet colour to a reddish tint. Should an excess of acetic acid be added, or should the solution when first tried change the colour of the test paper to a decided red tint, the bath is too acid (which would render the collodion very slow in action). This defect is removed by adding ammonia, diluted with ten times its bulk of water, drop by drop until the solution changes the test paper to a reddish violet tint, which indicates just that amount of excess of free acid that serves to ensure success in the production of negative pictures, and it is advisable frequently to test the nitrate of silver bath in order to remove either an alkaline or a too decided acid effect.

The glass plate having been coated with iodized collodion is laid on the dipper and *immersed steadily and without* HESITATION in the dipping trough, for if a pause should be made at any part, a line is sure to be formed, which will print in a subsequent part of the process.

The plate being immersed, must be kept there a sufficient time for the liquid to act freely upon the surface, particularly if a negative picture is to be obtained. *As a general rule it will take from two to four minutes, varying with temperature and make of the collodion.* In very cold weather, or indeed anything below 50° Fahrenheit, the bath should be placed in a warm situation, or a proper decomposition is not obtained under a very long time. Above 60° the plate will be almost certain to have obtained its maximum of sensibility by two minutes' immersion, but *as the plate cannot injure by remaining a longer time in the bath, it is better, in all cases when a negative picture is required, to give time for the whole of the iodide in the collodion to be thoroughly acted on by the nitrate of the bath.*

* See mode of observing the colour of test paper at page 30.

To facilitate the action, let the temperature be what it may, the plate must be lifted out of the liquid two or three times, which also assists in getting rid of the ether from its surface, for without this is thoroughly done an uniform coating cannot be obtained; *but on no account should it be removed until the plate has been immersed about half a minute,* or marks are apt to be produced.

Having obtained the desired coating, the plate is then extremely sensitive to white light, and therefore, we presume the operator has taken every precaution to exclude ordinary daylight.

The best way of doing this is to hang over the window two or three thicknesses of yellow calico, by which means the light which passes through will be amply sufficient for manipulation, and at the same time produce no injury to the sensitive plate.

If the foregoing plan cannot be followed, the room must be closed against any portion of daylight, and a candle alone employed, *placed at a distance* from the operator, to give the requisite light.

The plate thus rendered sensitive must then be lifted from the solution and held over the trough, that as much liquid as possible may drain off previously to being placed in the camera frame, and the more effectually this is done the better, or the action in the camera will not be equal over the whole surface; at the same time it must *not be allowed to dry*, but, in short, to obtain its full maximum of sensibility, it should be damp without superfluous moisture.*

The question is often asked,—How soon, after coating the plate with collodio-iodide, should it be immersed in the nitrate bath? Now this is a difficult question to answer. We have said the time of *immersion* is dependent upon temperature and make of collodion, so likewise must we be governed as to time *before immersion.* To make collodio-iodide, or xylo-iodide, for, chemically speaking, there is no difference in the two, it is necessary that the ether should contain a certain quantity of alcohol, or the different articles are not soluble; therefore, if we take a fresh bottle, and coat the plate from this while it contains its full dose of ether, and with the thermometer ranging between 60° and 70°, the evaporation of this article will be very rapid, and, consequently, a tough film soon formed; but if, on the other hand, we are using an article which has been in use some time, and many plates, perhaps, coated, the proportion of alcohol will be much greater, and, not being of so volatile a nature, will necessarily take a longer time to acquire the requisite firmness for immersion. Hence it is evident

* If the plate is allowed to become dry before exposing it in the camera, it loses its sensitiveness to the action of light. It is therefore imperative that the exposure takes place within a few minutes after removing the plate from the bath. This renders collodion of very little value for taking views, as in such situations we cannot always command the use of a dark room. For these purposes we must employ either the Calotype, waxed paper process, or the new collodio-albumen process.

we must be guided by circumstances. If, for instance, after coating a plate, we find, on immersion, it does not colour freely, we have then reason to suppose the plate has not been immersed sufficiently quick; but if, on the other hand, we find the film very tender, and, upon drying, it cracks, then we have reason to know that plates prepared from that bottle must not be immersed quite so soon. *The larger the proportion of alcohol the more tender the film, but the more sensitive will be the plate, and the quicker and more even will be the action of the bath.*

The next question also often asked is,—How long must be the exposure in the camera?—a question more difficult to answer than the last, without knowing something of the working of the lens and intensity of light. Practice alone can determine, combined with close observation of those parts which should be the shadows of a picture. If, for instance, in developing, we find those parts less exposed to the light than others develope immediately the solution is applied, then we have every reason to suppose the exposure has been too long; but if, on the contrary, they develope very slowly, we have proof that the time allowed has not been sufficient to produce the necessary amount of action. In a good picture we should see first the whites of a dress appear, then the forehead, after which we shall find, if the light has been pretty equally diffused, the whole of the face, and then the dress.

Much will, of course, depend upon the arrangement of light, for if the sitter is not placed in a good aspect, by which is meant a good diffused light, the prominent parts only will come out; or, to produce the necessary amount of action to obtain the others, the high lights are so overdone that the picture prints raw and cold.

Can I produce portraits at my drawing-room window? This is another common question, and the reply must necessarily be, Yes, if you have sufficient light, and can so place your camera that the sitter may be pretty equally illuminated, and not one half receiving nearly all the light; if it does, one side may be amply done and the other scarcely visible.

In cases of this description the necessary effect may often be produced by placing a white screen so as to reflect a portion of light upon the darkened side; but, upon the whole, a light of this character is better adapted for producing positive than negative pictures upon glass.

We must now suppose the plate to have received its necessary impress in the camera, and proceed to—

THE DEVELOPMENT OF THE IMAGE.

To effect this it must be taken into the room where prepared, and, with care, removed from the slide to the levelling stand. It will be well also to caution the operator respecting the removal of the plate. Glass, as before observed, is a bad conductor of heat; therefore if, in taking it out, we allow it to rest on the fingers at any one spot too long, that portion will be warmed through to the face, and on applying the developing solution

the action will be more energetic at those parts than the others, and consequently destroy the evenness of the picture. We should, therefore, handle the plate with care, more as if it already possessed too much heat to be comfortable to the fingers, and get it on the levelling stand as soon as possible.

Having then got it there, we must next cover the face with the developing solution.

This should be made as follows :—

Pyrogallic acid	. . . . .	5 grains.
Distilled water	. . . . .	5 ounces.
Glacial acetic acid	. . . .	1 dram.
Alcohol	. . . .	half a dram.

Mix and thoroughly filter.

Now, in developing a plate, the quantity of liquid taken must be in proportion to its size. A plate measuring five inches by four will require half an ounce; less may be used, but it is at the risk of stains; therefore, we would recommend, that half an ounce of the above be measured out into *a perfectly clean glass measure*, and to this add from eight to twelve drops of a solution of nitrate of silver, containing 50 grains to the ounce of water.

Pour this quickly over the surface, taking care not to hold the measure too high, *and not to pour all at one spot*, but, having taken the measure properly in the fingers, begin at one end, and carry the hand forward; immediately blow gently upon the face of the plate, which has the effect, not only of diffusing it over the surface, but causing the solution to combine more equally with the damp surface of the plate; it also has the effect of keeping in motion any deposit that may form, which, if allowed to settle, causes the picture to come out mottled. A piece of white paper may now be held under the plate, to observe the development of the picture ; if the light of the room is adapted for viewing it in this manner, well ; if not, a light must be held below; but in either case arrangements should be made to view the plate easily whilst under this operation, a successful result depending so much upon obtaining sufficient development without carrying it too far.

In some instances it is better not to mix the nitrate of silver solution with the pyrogallic solution until after the latter has been poured over the plate, but in no case must it be mixed *on the plate*, the solution must be poured off into the measure and the nitrate added. In this way we can judge better of the intensity of the picture, for when the solution is off, the plate can be held up to the light and the image viewed through. Care should be taken that the nitrate of silver solution is free from deposit.

The author has also found a weak developing solution, as given above, far more successful in obtaining gradation of tone than when stronger, for, in the latter case, the action will be very energetic on those parts reflecting the most light, and, consequently, become overdone before other portions,

such as dress, &c., have become sufficiently visible. The addition of an extra portion of nitrate of silver will be found to improve the tone, but this may be effected also without adding it to the pyrogallic solution; and, in many instances, it will be found a better plan to re-dip the plate in the bath, after exposure in camera, particularly if any considerable time has elapsed between the excitement of the plate and development of the picture, for the plate having dried unequally, does not allow the same uniform development as when well moistened over the surface.

As soon as the necessary development has been obtained, the liquid must be poured off, and the surface washed with a little water, which is easily done, by holding the plate over a dish and pouring water on it, taking care, both in this and a subsequent part of the process, to hold the plate horizontally, and not vertically, so as to prevent the coating being torn by the force and weight of the water.

This being done we arrive at the—

FIXING OF THE IMAGE.

Which is simply the removal of yellow iodide of silver from the surface of the plate, and is effected by pouring over it, after the water, a solution of hyposulphite of soda, made of the strength of four ounces to a pint of water. At this point daylight may be admitted into the room, and indeed we cannot judge well of its removal without it. We then see the iodide gradually dissolve away, and the different parts left more or less transparent according to the action of light upon them.

It then only remains to thoroughly wash away every trace of hyposulphite, for should any of this salt be left, it gradually destroys the picture. The plate should, therefore, either be immersed with great care, in a vessel of clean water, or, what is better, water poured gently and carefully over the surface.

After this it must be stood up to dry or held before a fire.

It may be as well to state, any clean filtered or rain water will answer for washing, distilled being only required for the solutions of nitrate of silver, &c.

Having, by the foregoing means, obtained and fixed a negative photographic image on glass, which is capable of producing positives upon paper by the printing process described at page 63; it is as well, previous to obtaining these, to render the tender film of collodion less liable to injury.

This is best accomplished by—

VARNISHING THE PLATE.

There are two kinds of varnishes which may be used for this purpose—the spirit and the chloroform. Some amount of care is necessary in the use of the spirit varnish, for if it is poured on the plate cold the gums

chill and the picture is rendered opaque; therefore, the best plan of proceeding is as follows:—

Hold the back of the plate to a fire until warm through, care being taken not to make it too hot, or the varnish will not run properly; then pour the varnish on in the same manner as the collodion, and return the superfluous portion to the bottle. Hold the plate again to the fire to drive off the spirit, when a beautiful surface will be obtained, making it difficult, at first sight, to judge which side has been varnished.

There is also another kind of varnish which has been recommended by Dr. Dymond, viz., gum amber, dissolved in chloroform. This is used by many photographers, as it can be put on cold, and dries directly upon evaporation of the chloroform, which is its only advantage over the spirit varnish, and is necessarily much more expensive.

ON THE CALOTYPE PROCESS.

BY F. HORNE.

The word *Calotype* is derived from two Greek words signifying "beautiful picture or image."

To produce a calotype picture there are five distinct processes, all of which, with the exception of the third, viz., exposure in the camera, must be performed by the light of a lamp or candle, surrounded by a yellow glass, or else in a chamber where the whole of the daylight that illuminates it first passes through a yellow glass, or several thicknesses of yellow calico; they are all very simple, but, at the same time, all of them require care and attention. The first, and not the least important, is—

IODIZING THE PAPER.

The first requisite in the calotype process is to obtain good iodized paper, for without this all our subsequent operations will be vain. For this purpose should be selected the best English paper, manufactured either by Whatman or Turner; the latter is generally preferred by most photographers as giving the most solid picture, but the former is very good and much more free from iron or black spots. The paper, being cut to the size required for the exposing frames of the camera, should be marked at one corner, in order to know the side prepared, and here it will be as well to observe that great care is requisite in handling the sheets. This should be done at the edges only, for the fingers, if allowed to touch the centre of the sheet, are apt to produce stains.

Take twenty grains of iodide of potassium and twenty of nitrate of silver; dissolve these, each separately, in two ounces of distilled water, and then mix them well together. A precipitate, the yellow iodide of silver, will be thrown down, which should be allowed to subside; the liquid may then be poured away, and the precipitate washed, by pouring on a small quantity of distilled water. This should likewise be poured off, and the measure filled up to one ounce with distilled water, and iodide of potassium, in crystal, added, until the whole of the precipitate is dissolved. *As a guide to those who have not before made this solution, it will be as well to tell them, that to accomplish the solution of the precipitate, will take from* 180 *to* 200 *grains of the salt.* It only then remains to filter the solution into a clean bottle, and it is ready to use, which is done as follows:

Pin the paper upon a clean board, and, with a dry and clean camel-hair brush, coat the surface over equally, and pin up to dry; repeat the same to any number of sheets. The paper then contains the iodide of silver, with excess of iodide of potassium. This latter salt must be got rid of, and to effect this the sheets require soaking in water; to do this most effectually, the best plan is to take a number of dishes, say six or eight, and immerse a sheet in all but one, taking care so to immerse them, that no air bubbles shall be attached to the surface; allow each to soak for about half an hour, and then remove them, one by one, into the dish that is empty, changing the water as each comes out; they should then soak for another half hour, and be taken out, and pinned up to dry; the more water each dish contains the better. Should it be inconvenient to adopt this plan, the sheets may be immersed in one large vessel, such as a clean foot-an, taking care not to immerse too many at one time, as the sheets touching each other prevent their being equally soaked; in this they may soak from one to two hours, occasionally slightly agitating the water by passing a rod round the side, to displace that in contact with the face of the papers; then remove each separately, pass through another water, and pin up to dry.

This constitutes the iodized paper, and too much care cannot be taken in its preparation, as success in the future operations depends so much upon its being good and properly made; it is generally considered to keep any length of time, but my experience will not allow me to say the same. I am aware that if the picture is taken, and developed directly, it may be used when months old, but if the prepared sheets are required to be kept some hours before the picture is brought out, then, in that case, it should not be more than from six weeks to two months old. A well prepared sheet, when new, and I call it new if the age does not exceed that stated above, will, when excited, keep good for twenty-four hours, and the whites of the picture will keep from turning brown in the development, but when too old these disappear, and the whole becomes brown together.

The iodized paper thus prepared is not in the least sensitive to light, and indeed it tends to improve the same, by exposing the sheets to the direct action of the sun.

EXCITING THE PAPER FOR THE CAMERA.

For this purpose two solutions are required, termed aceto-nitrate of silver and solution of gallic acid : the aceto-nitrate is made thus :—

Nitrate of silver	50 grains.
Glacial acetic acid	$1\frac{1}{2}$ dram.
Distilled water	1 ounce.

Mix and filter.

The solution of gallic acid is made as follows :—

Alcohol	2 drams.
Gallic acid	5 grains.
Distilled water	6 drams.

Mix the gallic acid with the alcohol, add the water, and filter for use.

The aceto-nitrate solution, call A. The gallic acid solution, call B.

Also make diluted solutions of the above, thus :—

Aceto-nitrate of silver, A. 1 dram.
Distilled water, 7 drams.—Call this No. 1.

Solution of gallic acid, B. 10 minims.
Distilled water, 1 oz.—Call this No. 2.*

I may mention here, that the greatest care must be taken, both in this and in all photographic operations, to have the solutions clear and bright, and measures perfectly clean, as constant failures arise from these causes, or from wiping the measure with cloths that have been used to wipe up hyposulphite of soda, or other chemicals accidentally spilt. When the distilled water, aceto-nitrate of silver, and gallic acid solutions are good and the measure clean, they will keep mixed for hours in the dark without changing colour, but the slightest trace of any other chemical on the measure or the rod, will immediately produce sufficient change to cause total failure. Let me therefore advise those anxious to become proficient in this art, to look well to these minutiæ, and if upon mixing these solutions they observe the slightest change, to reject them at once and clean the measure with another cloth.

We now proceed to excite the paper, which must be done in the dark room, as directed at page 32, and may be effected in two ways, either with the Buckle's brush or with a smooth glass rod.

To prepare and use the Buckle's brush, proceed as follows :—Take a tuft of the finest cotton wool, about the size of a hen's egg, draw it out thin in the middle, to a form resembling an hour glass, place the thin part in the silver wire hook (supplied with the glass tube for the purpose), and with it draw the cotton tightly into the bell-mouthed tube. Pull out all the superfluous fibres of the wool which readily yield, and revolve the

* In hot climates, and in very hot weather, dilute the solution No. 1 and No. 2, with an equal bulk of water.

remainder in the palm of the hand a few times to condense it into a ball. Now lay a sheet of clean white blotting paper upon the preparing board, and on this the iodized paper to be excited, marked side upwards, and, having pinned them to the board by the two upper corners, hold the board in a slightly inclined position between yourself and the light, and apply equal parts of Nos. 1 and 2 mixed together in a clean measure, plentifully, with a full brush, both across the paper and from the top to the bottom, always keeping a flowing edge. Having continued to apply the solution until the paper is thoroughly saturated, and will not take up any more, remove that which remains with blotting paper. The cotton of the brush requires renewing for each sheet.

To use the glass rod; having fastened the blotting paper and the iodized paper upon the preparing board, as stated for the Buckle's brush, place the rod across the left portion of the sheet at a short distance from its edge, and pour a measured* quantity of the solution in front of it. Move the rod to and fro till the solution is equally spread, and the whole surface wetted: allow a few seconds for the liquid to be absorbed.

The pins should be removed as soon as the paper will remain without bending up, and when the pins are removed the solution can be applied right up to the corners and edges of the sheet. The whole of the surface, when well covered, if held towards the light, which passes through the yellow medium, should by reflection, show a uniform shining surface, and yet the solution should not run off; it should also appear uniformly transparent when viewed by transmitted light.

When this is accomplished, proceed with a piece of clean bibulous paper to remove the superfluous solution from the surface, and place the excited paper, if the picture is to be taken directly, in the camera frame; but should it be required to keep them some hours, place each sheet between folds of clean bibulous paper, that they may become nearly or quite dry, without an unnecessary exposure to the atmosphere.

This also prevents cockling in the frame, which will invariably take place if put in too wet and there allowed to dry. Another advantage also results from placing them between folds of bibulous paper previous to placing in exposing frames, viz., we are enabled to see if a change has taken place, by the surface becoming discoloured, for if it has, the sheet had better be at once rejected, for the longer it is kept the worse it will become, and to obtain a picture, worth looking at, is out of the question; but if the iodized paper has been properly prepared, the solutions good, and the different articles used made perfectly clean, not the slightest change will be visible for hours after the paper is excited, of course keeping them entirely from white light.

About half an hour to an hour will be quite sufficient for the sheets to

* One dram of each solution mixed together is required for a piece of paper 9 inches by 7, when the Buckle's brush is used, and half a dram of each, with the glass rod.

remain in the bibulous paper, during which time the glasses of the camera frame should be thoroughly cleansed and everything else arranged.

The next process is that of exposure in the camera.

EXPOSURE IN THE CAMERA.

For this, as the operator must be guided by his own judgment, few directions can be given, and few are required. He must choose or design his own subject, and judge of the time required, which will vary from three to six, eight, or ten minutes. On this account it is better to work as much as possible with one size diaphragm, for if we keep changing to first one size and then another, the great variation in the quantity of light admitted, makes it utterly impossible to judge properly. A good lens of twelve or fourteen inch focus will work well, under most circumstances, with half an inch opening. The object to be taken should be well lighted, and, if possible, the time selected when good shadows can be obtained. The operator must also be guided in his time of exposure, as to the time that is likely to elapse before the picture will be developed. If, for instance, the picture is near his own residence, and to be developed directly, then in that case he will give the full time, say eight or ten minutes; but if some hours will elapse, then the exposure should not be for more than five or six. The paper, if removed from the frame directly after the picture is taken, should present but little or no change, but if kept some hours, the picture becomes more and more visible. Over-exposure tends to produce a rottenness when the picture is brought out.

The next process is that of

BRINGING OUT THE PICTURE.

This operation, like the preceding, requires the greatest care, and must, of course, be likewise conducted either by the aid of artificial light, which should be as feeble as possible and kept at a distance, or by a yellow light from a window. The method of proceeding is as follows:—

Pin the sheet of paper, when taken from the camera frame, upon the preparing board, as before, to excite it, and mix the solutions in the following proportions:—

Aceto-nitrate of silver, A.	. . .	10 minims.
Solution of gallic acid, B.	. . .	50 ditto.

Stir these together, and spread them equally and quickly over the surface, when the image, if before invisible, will immediately begin to develope itself, and if, as is the case when the papers have been kept some hours, the image is slightly visible, then also it will tend to make it more and more so. Care should be taken that the surface does not become dry, and immediately it appears as if all the solution has become absorbed into the paper, then more must be spread over.

The development must be continued until the whole of the detail has been brought out, and the darks of the pictures have become of suffi-

cient density to prevent light passing through them in the after process of printing. To judge of this, one end should be occasionally lifted and held before a light. Practice alone can teach a person when to stop, he must be guided entirely by the appearance it presents when held to the light, bearing in mind the picture will be rendered more transparent when waxed. On this account the development may often be continued until the picture seems almost lost.

The desired result being obtained, it only then remains to submit the picture to the next operation, which is

FIXING THE IMAGE.

The object in this process being to remove the excess of nitrate of silver' and also the yellow iodide of silver, it will be found advisable, in the first instance, to wash the picture or photograph, as it may now be termed, in two or three waters. The greater portion of nitrate of silver being removed by the washing, the remainder, together with the iodide of silver, is to be dissolved out by placing the photograph in a solution of hyposulphite of soda, containing about two ounces to the pint of water; it may remain in this solution till the yellow colour of the iodide disappears, after which it must be washed in a considerable quantity of common water, and finally, to ensure the whole of the hyposulphite of silver being removed from the paper, may be suffered to remain for hours in a fresh quantity of water, two or three times changed; on removal from which, and drying between folds of blotting paper, it will be found perfectly fixed, and will undergo no further change when exposed to the light. The image being now fixed, *and the picture thoroughly dried*, it only remains to be "waxed," in order to make the paper uniformly transparent: the method of doing this is the same as described for the waxed paper process, page 50, in the paragraph "Waxing the Paper."

The photograph thus obtained is a *negative* picture, *i.e.* the positions of the objects, together with all the lights and shades, are reversed in respect to their natural appearance, and, although its production may appear somewhat tedious, it will be found by no means difficult. If the chemical agents be perfectly pure, the apparatus properly constructed, the *intention* of each separate process kept in view, and the manipulation recommended correctly followed, the operator may rely with confidence on a satisfactory result.

The negative photograph obtained by the process described in the preceding pages is capable of yielding a vast number of beautiful impressions, in which the relative positions and perspective of the various objects, and their lights and shades, will be correct as in nature. The method of obtaining these impressions as regards the prepared paper, &c., employed, will be found described at page 65, under the method of printing from glass negatives, the operation in both cases being similar.

WAXED PAPER PROCESS.

THIS process may be divided into seven distinct operations, *viz.*:—Waxing the paper, iodizing, rendering sensitive, exposure in camera, development of image, fixing the negative proof, and waxing the negative proof.

WAXING THE PAPER.

The kind of paper most suitable for this process is "Canson freres," and should be thin; having cut the paper into sheets of the size required, they are coated or rather saturated with wax. This can be done in the simplest manner by using a shallow flat tin vessel, slightly larger than the paper to be prepared, which is supported over a moderate source of heat (a vessel of boiling water answers very well). If a cake of white wax be rubbed on the bottom, it will quickly melt and form a stratum or bath of liquid wax, on which one of the sheets of paper at a time is then laid, and allowed to remain a second or two to absorb; it is then removed and placed between some sheets of smooth bibulous paper, over which you pass a moderately hot iron to remove the excess of wax. It is very essential that the wax should be entirely removed from the surface, and that it remain only in the texture of the paper. A sheet well prepared should not have any shining points on its surface when viewed by reflected light, and should be equally transparent all over.

The iron is sufficiently hot when a drop of saliva, let fall on its surface, very quickly evaporates without running off its surface. If hotter, it spoils the wax and stains the paper.

IODIZING THE WAXED PAPER.

For this purpose prepare a bath in the following manner:—

Iodide of potassium . .	4 drams.
Bromide of potassium . .	2 ,,
Iodine	4 grains.
Honey	1 ounce.
Distilled water . . .	1 pint.

The proper method of mixing the foregoing, is to put the iodide of potassium into the vessel in which the mixture is to be made, along with a small quantity of water, just to dissolve it, and stir them well together with the glass rod; then add the iodine, which soon becomes perfectly dissolved by continuing the stirring; when this is ascertained to be the case, the remainder of the liquid and the other ingredients are to be added, and the whole, after well stirring together, must be carefully filtered through bibulous paper, and retained for use in a stoppered bottle.

When the waxed paper is to be prepared, pour some of this solution into a large dish, and completely immerse the waxed paper, sheet by sheet, and one above the other, taking care to remove any air-bubbles that may be produced.

From fifteen to twenty sheets may be prepared at a time, and must be left to soak for twelve hours, according to the thickness of the paper.

Turn over the whole mass so as to commence at the first sheet immersed, and hang them up to dry by pinning them by the corner to a string stretched horizontally in the air. Afterwards apply to the lower corner of each sheet a piece of blotting paper, which will easily adhere and facilitate the removal of the superfluous liquid.

When the paper is dry, cut it to the size of your camera and keep it in a portfolio for use.

The liquid that remains after removing the paper may be poured into a bottle, and will serve to prepare other paper until it is exhausted. It only requires to be filtered just before being used.

RENDERING THE PAPER SENSITIVE.*

For this purpose make a mixture of—

Nitrate of silver	3 drams.
Glacial acetic acid	3 drams.
Animal charcoal	2 scruples.
Distilled water	8 ounces.

This solution, which may be termed aceto-nitrate of silver, should be retained in a stoppered bottle for use. When the iodized waxed paper is to be rendered sensitive, filter a portion of the above aceto-nitrate of silver into a flat porcelain dish until it covers the bottom to about a quarter of an inch, then immerse a sheet of the paper completely, only taking care to avoid air bubbles; allow it to remain for ten minutes, then remove and wash it immediately in a bath of distilled water, or what is preferable, in two portions of distilled water; in which case, two porcelain pans should be employed containing the distilled water. The iodized waxed paper on removal from the aceto-nitrate bath is placed at once into the first portion of distilled water, just drawn through it three or four times, and then removed to the second dish of water and the washing repeated in the same way; it is then removed and dried between some folds of smooth and fresh bibulous paper, and kept for use in a paper case of the same material. A considerable number of sheets of paper may be rendered sensitive in the same quantity of aceto-nitrate, which should be returned, after being used, to the bottle and kept on the animal charcoal.

* This operation must be performed in a dark room, see page 32.

EXPOSURE IN THE CAMERA.

The time usually required for producing an impression in the camera will of course vary with the varying intensity of the light: in full sunshine with a single view lens of fourteen inch focus and a half inch stop, about eight minutes will suffice, but a greater or less length of exposure is not of so much importance, as the subsequent development of the picture can be regulated accordingly.

DEVELOPMENT OF IMAGE.

This is done by immersing the picture in a saturated solution of gallic acid made by dissolving one dram of gallic acid in 20 ounces of distilled water and filtering. Pour this mixture into a shallow basin to the depth of about a fifth of an inch, and completely immerse the proof, taking care that there are no bubbles of air. When the picture begins to appear, pour off the gallic acid solution into a clean glass measure, and to each eight ounces of the solution, add thirty drops of solution of nitrate of silver containing thirty grains to the ounce.

According to its development, which is easily perceived through the thickness of the paper, it must be left in the bath from ten minutes to one hour, or more, until it arrives at its perfection, which in some instances may be a day or two, according to the time exposed in the camera.

When the proof is well developed, remove and place it in another vessel and wash with several waters, lightly rubbing the back with the finger to remove the crystalline deposit which might cause stains.

The tone which the picture assumes under the action of the gallic acid indicates if the time of exposure has been correct.

If the proof has a blackish grey appearance all over, it has been exposed too long; if the high lights, which ought to be the blackest parts of the negative, are not deeper than the half-tints, the exposure has still been too long. If the time of exposure, on the contrary, has been too short, the lights will be but feebly defined. If the time has been correct, a superb proof will be obtained, having the lights and shades well defined and transparent.

This operation can be accelerated in cold weather by slightly warming the gallic acid.

The picture thus obtained is not permanent. It must be rendered so by the following operation, having first washed it in water.

FIXING THE NEGATIVE PROOF.

Make, in a bottle, the following solution:—

Hyposulphite of soda	2 ounces.
Filtered water	1 pint.

Pour a sufficient quantity of this solution into a porcelain pan to cover about one-quarter of an inch in depth, and plunge the negative proof into it completely, taking care to avoid air-bubbles.

One proof only at a time should be put into the bath; it will nevertheless serve for several proofs, one after the other.

The solution of hyposulphite which has been used is poured into another bottle and allowed to remain quiescent for some time, when a precipitate of gallate and sulphuret of silver will be formed; it is then filtered and forms an excellent solution for fixing feeble positive proofs.

The proof should be left in the bath of hyposulphite until the yellow tint of the iodide of silver is removed; it should not be left too long, otherwise the blacks of the picture suffer; from ten to fifteen minutes is usually sufficient.

The negative when removed from the hyposulphite should be washed in several waters, and afterwards left in a large vessel of water for half an hour to remove the whole of the hyposulphite.

The proof is now fixed and may be suspended in the air to dry.

WAXING THE NEGATIVE PROOF.

This is done by holding the proof before a moderate fire, so as to give to the wax that transparency which it loses by the successive baths; for they are likely to give a soiled appearance to the paper, which however, generally disappears by this operation.

Positive pictures are obtained from these negatives in precisely the same manner as described at page 65, for calotype or glass negatives.

THE COLLODIO-ALBUMEN PROCESS.

BEING THE SUBSTANCE OF A PAPER READ BEFORE THE NORTHAMPTON PHOTOGRAPHIC SOCIETY, AUGUST 13TH, 1856.

BY W. ACKLAND.

It is now generally admitted by all photographers, that negatives taken on glass far exceed any of a similar production on paper, both as regards rapidity of action, beauty of definition, and ease in manipulation; but it must be also allowed that there are very serious objections to the general adoption of the collodion process (as usually employed) for pourtraying the various points of interest a photographic tourist may meet with on a journey.

The main objection to the use of collodion for taking views is its loss of sensitiveness when once the excited film becomes dry; hence, it is necessary to prepare the plates, expose them in the camera, and develope the latent image within a very short time—too short, indeed, to be of much utility in taking landscapes, &c., except those situate within a few minutes' walk of the operating room. To obviate this, many adopt the plan of carrying with them a portable tent covered with some material that only admits yellow light; or they employ a camera so constructed, that the plate may be sensitized and the image developed within the body of the instrument. But unfortunately both these plans present many inconveniences: the tent especially, with the materials necessary to be used, being bulky and not of easy transport, while the heat within under a burning sun is most oppressive, and the manipulation much more difficult than when operating at home. To remedy these objections, many plans have been adopted; and among the first may be mentioned the use of nitrate of magnesia and nitrate of zinc by Messrs. Spiller and Crookes. These materials, by their deliquescent properties, keep the surface of the excited film over which they are spread slightly moist, and in a condition to receive the impressed image. Another and more simple mode of proceeding is the use of honey, as introduced by Mr. Shadbolt; but these processes have not yielded that constant success which is so essential to enable the amateur to practise them.

The great objection to the above is, that in order to render the plate sensitive, a definite amount of nitrate of silver must remain on its surface; and to obtain this *exact* quantity is more a matter of chance than certainty. If too much remains, it crystallizes on the plate and destroys the continuity of the collodion film; if too little, it is less sensitive to light. Another evil is the tenderness of the collodion film during the development of the image, more especially if, from want of sufficient exposure, the develop-

ment requires to be long continued. Dr. Mansell has also introduced a plan by which stains, which sometimes occur, may be obviated, but still it must be admitted that these processes fail in the hands of the majority of amateurs; although the gentlemen above referred to, and other skilled photographers, have produced the most charming results by them. Mr. Llewelyn's oxymel process has nearly the same objections as the honey process, partaking as it does of many of its defects and advantages.

The invention of Dr. Taupenot, however, which is termed the collodio-albumen process, has none of the inconveniencies of the foregoing, and yet retains all their advantages; and it is this process which this paper is intended to bring under your notice. When the imperfect instructions, as given by the inventor, were followed out, results were obtained which promised ultimate success, provided the failures which sometimes occurred could be traced to their cause and remedied. These failures were of such a nature that the amateur would possibly have been induced to give up the process in despair; but it is considered that the following directions may be confidently relied upon for success where the manipulations are carefully performed. My attention was called to this subject on its first publication in France, and the results I obtained (although failures were frequent) convinced me that when once their causes were understood, this process would be generally employed for taking landscapes and still-life pictures; and with a view to discover them, I devoted all my spare time to the subject, and published the result in December last, in the form of a chapter on this process, in "Thornthwaite's Guide to Photography." This has placed my description in the hands of many photographers and amateurs, and as a natural consequence I have received numerous letters containing the various failures of my correspondents: some of these I had previously met with, others were new to me. I, therefore, in June last, commenced making a new series of experiments, and I now propose to give the results of my extended investigations, merely premising that if the directions I shall give are strictly followed, success must be the natural consequence, as I can venture to assert that failures are less frequent in practising this process than in any other. Before entering into the general description, it may be as well to mention the advantages of this process over all others for depicting the varied scenery that the traveller meets with in his daily rambles. In the first place, a stock of plates sufficient for a fortnight's use may be prepared before leaving home, exposed in the camera as opportunities offer, and the development left until returning: there is also no process existing where the time of exposure may be so varied as in the collodio-albumen. In the third place, if the exposure has been one-third more than would have been sufficient, a little less silver in the developing fluid restores the balance, while an under-exposed picture may often be fully brought out by an increased dose of the silver developing fluid; indeed, it is only necessary to expose for the deepest shades,

as the high lights have but little tendency to suffer from over-exposure. I also think, when viewing the specimens before you, it will be found that for beauty of definition, developement of middle tints, and artistic contrasts of light and shade, the collodio-albumen excels every known process; whilst its freedom from failures is such, that forty-nine good negatives may be fully anticipated from fifty carefully prepared plates.

The solutions necessary for this process are—

Cleansing solution.
Collodion bath solution.
Dilute nitric acid.
Dilute ammonia.
Tincture of iodine.
Sugar solution.
Albumen bath solution.
Negative collodion and iodizing solution.
Pyrogallic solution.
Silver developing solution, and
Fixing solution.

CLEANSING SOLUTION.

Tripoli	2 drms.
Cyanide of potassium . .	2 drms.
Rain or distilled water . .	2 oz.

Dissolve the cyanide of potassium in the water, then add the tripoli, and shake well together until perfectly mixed.

DILUTE NITRIC ACID.

Nitric acid	$\frac{1}{2}$ drm.
Water	2 oz. Mix.

DILUTE AMMONIA.

Liquid Ammonia	$\frac{1}{2}$ drm.
Water	2 oz. Mix.

TINCTURE OF IODINE.

Iodine	$\frac{1}{2}$ drm.
Alcohol	1 oz. Mix.

SUGAR SOLUTION.

White sugar . . .	2 oz.
Acetic acid	1 drm.
Water	1 oz.

Dissolve the sugar in the water, then add the acetic acid, and filter for use.

COLLODION BATH SOLUTION.

Nitrate of silver . . .	$1\frac{1}{2}$ oz.
Iodide of potassium . .	3 grs.
Carbonate of soda . .	5 grs.
Distilled water . . .	20 oz.

Dissolve the nitrate of silver in 3 oz. of the water, the carbonate of soda and the iodide of potassium each in $\frac{1}{2}$ oz. of water separately. When perfectly dissolved, mix these three solutions and shake well together so as to thoroughly incorporate them; then add the remaining 16 oz. of water and again shake well together. Now add dilute nitric acid drop by drop until the solution, when applied to a leaf of Clark's test-paper, turns its violet colour to a slightly reddish tint; to this add $\frac{1}{2}$ drm. of dilute nitric acid, filter, and the solution is ready for use. Should too much dilute nitric acid have been previously added, so that the leaf of Clark's test-paper turns to a decided red colour, it must be neutralized by adding a few drops of dilute ammonia until the colour of the test-paper is but slightly change to redness; then add the $\frac{1}{2}$ drm. of dilute nitric acid as before specified. This testing of the bath solution is one of the *most important* chemical manipulations that occur in photography, and the amateur frequently fails, from imagining that sudden changes of colour will be produced on the test-paper on applying the bath solution; but this is not to be expected, for the proper amount of change is very slight, although sufficiently evident to a careful observer; the least tendency to blueness indicating an alkaline condition, and the smallest amount of redness an acid condition; whereas if no change of colour is produced, the solution is said to be neutral. In order to observe these slight changes of colour, a perfectly clean glass rod should be dipped into the solution and the wetted part applied to the coloured side of the test-paper, so as to leave a drop of the fluid in contact with the surface; this is allowed to

remain one minute, then shaken off, and the change produced observed in good *daylight* (as artificial or even dull light is not sufficient). It is advisable to test the bath solution from time to time in order to ascertain that it retains its original normal condition of slight acidity; and should such not be the case, it must be remedied, as before stated. It is recommended to prepare twice as much of this solution as will be needed for the collodion bath, as it is used in combination with acetic acid to form the albumen bath solution.

ALBUMEN BATH SOLUTION.

Collodion bath solution . .	20 oz.
Glacial acetic acid . . .	$\frac{1}{4}$ oz.
Kaolin	$\frac{1}{2}$ oz. Mix.

This solution must be carefully filtered before using; but it is advisable to allow the kaolin to remain at the bottom of the bottle when the fluid is not in use, as it has the property of preventing the bath solution from becoming brown by use.

IODIZED COLLODION.

Negative collodion . . .	6 drms.*
Iodizing solution . . .	2 drms.
Glycerine	1 drop.
Tincture of iodine . . .	6 drops.

These must be mixed together, and allowed to settle for at least twelve hours; then pour off the clear solution into a perfectly clean bottle in order to get rid of any insoluble or floating particles. The above iodized collodion will retain its sensitiveness not longer than a fortnight; it is, therefore, advisable to mix no more than can be used in ten days.

IODIZED ALBUMEN.

White of egg (free from yolk) .	10 oz.
Honey	1 oz.
Yeast	1 table spoonful.
Iodide of calcium	20 grs.
Bromide of calcium	10 grs.
Water	1 oz.

Dissolve the iodide and bromide of calcium in the water, then add it to the white of egg, honey, and yeast previously mixed together and contained

* The Negative Collodion and Iodizing compound supplied by Horne and Thornethwaite, answers admirably.

in a tall glass jar of at least one pint capacity; tie a piece of paper pierced with holes over the top to keep out dust, and place the whole near a fire or in a warm situation, where the temperature is not lower than 70° nor higher than 90°. In a few hours fermentation commences, which is evident by bubbles of gas rising through the liquid. This action continues for four or five days; when it ceases, filter the whole through a double thickness of fine muslin.

This filtered liquid is the iodized albumen, which, if put up in 4-oz. bottles and stowed away in a cool situation, will keep good for months.

Those who object to the trouble of preparing this fluid can purchase it ready for use.

PYROGALLIC SOLUTION.

Pyrogallic acid . . .	15 grs.
Glacial acetic acid . . .	2 drms.
Distilled or rain water . .	7 oz.

Dissolve the pyrogallic acid in water, then add the acetic acid, and filter for use.

SILVER DEVELOPING SOLUTION.

Nitrate of silver . . .	1 drm.
Acetic acid	2 drms.
Distilled or rain water . .	7 oz.

Dissolve the nitrate of silver in the water, then add the acetic acid, and filter.

FIXING SOLUTION.

Hyposulphite of soda . .	2 oz.
Water	1 pint.

Dissolve.

CLEANING THE PLATE.

The glass usually employed for this purpose is patent plate, which can be obtained of all the usual sizes used by photographers ready cut, and the edges slightly ground. Having selected a plate that fits the plate-frame of your camera, pour a tea-spoonful of the cleansing solution over the centre of the plate, and with a linen pledget well rub it over every part back and front, then rinse in an abundance of cold water to remove every particle of the cleansing solution, wipe dry with a fine diaper cloth, and polish with a second cloth of the same material.

COATING WITH IODIZED COLLODION.

This is performed in the usual manner, taking especial care that no floating particles exist in the iodized collodion or the atmosphere of the operating room.

EXCITING THE COLDODION FILM.

The plate, after being coated with iodized collodion, and the ether on its surface allowed to evaporate, so that the film appears set, must be plunged (by the aid of a glass-dipper) with one downward movement into a bath filled to within an inch of the top with collodion-bath solution; after being allowed to remain undisturbed for one minute, it is then partially lifted out three or four times, to facilitate the removal of the oily appearance it presents. When the surface appears uniformly wetted, the plate is removed from the dipper, allowed to drain a few seconds, and is then placed, collodion side upwards, on a levelling-stand, and a moderate stream of water allowed to run over its surface from a tap for at least two minutes, so as to wash off every particle of the bath solution. The plate is now removed from the levelling-stand, the back well washed with water, and then placed nearly upright (with the face against a wall) on *clean* filtering paper for one minute to drain. This takes place more effectually if the plate rests with one corner only on the filtering-paper; for if the entire edge of the plate touches it, capillary attraction prevents at least one inch of the lower part from being effectually drained.

COATING WITH ALBUMEN.

Having allowed the plate to drain one minute, pour over its surface a mixture of 7 drams of iodized albumen and 1 dram of sugar solution; pour off this mixture into a measure, and again cover the plate three separate times, so as thoroughly to mix the albumen with the moisture on the plate; then drain off as much as possible of the albumen mixture, and place the plate nearly upright on one of its corners on clean filtering-paper, with the face against a wall to dry, which takes place in about one hour. This drying may with advantage be effected by the application of artificial heat; taking care that the temperature does not exceed 130° Fahr. In coating with albumen, the presence of dust or air-bubbles must be guarded against as much as possible, and the albumen mixture must in all cases be strained through a double thickness of fine muslin just previous to its being used. The albumen mixture which drains off from one plate may be used to coat a second one; but as it becomes slightly diluted with the moisture of the plates, it is advisable not to use it for a third, nor to mix more of the iodized albumen and sugar solution than can be used in one day. The plates, when dry, may be excited at once, or stowed away in

plate-boxes for use, as in this condition they have been kept for six months, and I see no reason why they should not keep for as many years, provided they are thoroughly screened from damp and chemical fumes.

EXCITING THE ALBUMEN COATING.

Prior to the plates being excited they must be completely dry and free from dust; then, having taken a dipping-bath large enough to hold the plate, a sufficient quantity of the albumen bath solution must be filtered to fill it. The plate is now lowered into it with one steady downward movement, and allowed to remain one minute; then taken out and the excess of the bath solution drained off. It is now placed on a levelling-stand (albumen surface uppermost) and a stream of water allowed to fall on it from a tap for at least two minutes, as we have to wash off every particle of the bath solution, which appears to adhere with such tenacity as to take considerable force to remove it. When the plate is thoroughly washed, lean it against the wall of the dark room to dry, and when perfectly dry, *but not till then*, it is ready for exposure in the camera. Of course it will be quite understood, that from the time the plate is collodionized, white light cannot be allowed to fall on it; these operations and the after development being performed in a room entirely shielded against the intrusion of white light.

EXPOSURE IN THE CAMERA.

This operation may take place as soon as the plate is perfectly dry, or may be deferred for a fortnight. The time of exposure in the camera depends on so many conditions that it is impossible to give exact data. The stereoscopic specimens I now exhibit were taken with a Horne and Thornthwaite's stereoscopic lens, having a $\frac{3}{8}$-in. diaphragm, in forty seconds. With one of their landscape lenses of 14-in. focus and $\frac{1}{2}$-in. diaphragm, producing 9×7 pictures, the time of exposure in good light would be one and a half minutes, or if the object is in deep shade, three minutes would be required; but at all times, expose for the deep shades, and the high lights will not be much influenced by the over-exposure.

DEVELOPING THE IMAGE.

The plate on being taken into the operating room is placed on a levelling-stand, and distilled or filtered rain-water poured over it for half a minute, so as completely to moisten the surface and remove any particles of adherent dust; then drain slightly and pour over its surface, so as to cover every part, a mixture made by adding 1 dram of silver developing solution to 5 drams of pyrogallic solution (made as before described). Allow this to remain on for two or three seconds, and afterwards pour on and off

repeatedly until the general outline of the picture appears; when this takes place, pour off and well wash the plate. Should any stains have occurred, remove them by brushing the surface with a camel's-hair brush. Now mix another quantity of silver developing and pyrogallic solutions in the same proportions as before, and pour this on and off the plate, until the details of the picture are well brought out and the high lights sufficiently intense; on this being accomplished, drain off and thoroughly wash with water. The picture is now ready for the next operation—fixing the image. Should the developing fluid become muddy, pour it off, well wash the plate, and contieue the development with fresh solutions made as before. If the picture begins to develope in less than one minute after applying the developing mixture, drain the plate completely, well wash with water, and continue the development with a mixture containing only half the quantity of silver developing solution; or should no appearance of the picture take place after two minutes' application of the developing mixture, use equal parts of silver developing and pyrogallic solutions. In general, a good picture takes five minutes to develope, and the condition of the sky will serve to indicate whether the proper amount of exposure has been given. An under-exposed picture has a dense sky, but the details in the deep shades are deficient; whereas in an over-exposed picture the details are well out, but the sky is transparent and generally of a reddish tint; such pictures moreover possessing no contrasts of light and shade; whereas when the proper amount of exposure has been given, the sky is perfectly opaque, the middle tints finely developed, and the details apparent in the deepest shades with perfect contrasts of light and shade: as an example I refer you to the photograph of the mortar in St. James's Park. I cannot pass on to the next step without giving a caution against the use of imperfectly cleaned measures and vessels to contain the developing fluid; these are constant causes of failure, and must be carefully avoided.

FIXING THE IMAGE.

The plate, having been thoroughly freed from the developing fluid by washing, is placed on the levelling-stand, and the surface covered with fixing solution. In a minute or two the yellow opalescent colour of the film will disappear; and when this occurs, well wash with water, and examime the picture in good daylight, to ascertain if a thin film of silver has been formed on the surface during the development, as this formation frequently happens; if so, it must be removed. This, however, is easily done by friction with a camel's-hair brush and a stream of water. Lastly, lean the plate against the wall to drain and dry; when dry, it may be varnished with crystal varnish in the usual manner.

Having thus given such details as I hope will enable any one to follow out this process with every chance of success, I think I cannot conclude

without saying a few words on the failures that have occurred to myself and others in following the directions as originally published, and afterwards giving my explanation of their causes and the remedies I adopt to prevent their recurrence. The failures are,—1st, fogging of the collodion film; 2nd, fogging of the albumen coating; 3rd, blistering of the albumen coating; 4th, stains during developments; 5th, minute holes in the skies. The great cause of the fogging of the collodion film arises from the presence of subsalts of silver in the collodion bath, which will exert their baneful influence, although acid may be added to prevent it; these subsalts are formed by decomposition in the process of manufacture of nitrate of silver, and have been present (in minute quanuities) in every sample I have examined for the last twelvemonths. I have found that on adding a solution of carbonate of soda to a nitrate of silver solution, containing a small quantity of a subsalt, that the nitrate is left untouched until the whole of the subsalt is converted into carbonate of silver. For this reason I add carbonate of soda to the bath solution to convert the whole of this deleterious agent into carbonate, and then I decompose this carbonate into nitrate of silver by the addition of nitric acid. A solution is thus obtained free from any subsalt, and when slightly acidified, as before described, yields pictures free from fogging, provided the collodion used is not alkaline. This I avoid by adding the tincture of iodine, for it is a fact beyond dispute that an alkaline collodion will yield foggy pictures although excited in a very acid bath.

Fogging of the albumen coating was for some time a source of annoyance; but I found it to be caused by the constant tendency which the iodized albumen possesses to become alkaline. This is prevented by adding an acidified sugar solution to it just prior to coating the plate. Fogging may also be caused by the collodion and albumen baths becoming alkaline; the mode of remedying this has been already given. The use of impure samples of kaolin, containing carbonates, often causes the albumen bath to lose its acidity; to avoid which I always steep the kaolin employed in common vinegar, and then well wash it with water previous to adding it to the bath solution.

Blistering of the albumen coating is one of the most serious failures that can occur, but this I have entirely overcome. This blistering arises from an imperfect union of the collodion with the albumen, as the latter, on being wetted in developing, expands and forms the blisters; allowing the developing fluid to enter and produce star-like stains. These are avoided by using a collodion which, on being excited, yields a rich creamy film, the tenacity of which is not too great, and with a surface possessing a microscopic roughness. These conditions are obtained by adding glycerine in minute quantities to the iodized collodion, which not only produces these effects, but, by altering the mechanical condition of the film, increases its sensibility; for I view the collodion merely as a vehicle for the iodide

of silver, and am convinced that the mechanical condition of the iodide of silver governs its sensibility. I have always noticed that a film which appears smooth, when examined microscopically, is far less sensitive to light than one having a rough appearance. Collodion frequently yields this microscopically rough film without any additions; but this property being as frequently absent, the addition of glycerine is always to be recommended, as it has the power of breaking up the otherwise close texture of the iodide. This rough surface is also essential to prevent blistering, as the albumen enters between, and is bound close to, the collodion coating, and retains it in such a condition, that it is highly sensitive to light. Another cause of blistering is the use of albumen obtained from stale eggs; but this is easily remedied by using none but those newly laid.

Stains appearing during the development occur when the washings are imperfectly performed, and are often a source of annoyance to amateurs; I, therefore, would recommend very great care to be taken that this part of the operation is thoroughly attended to, and you will be free from failures arising from this cause.

Minute holes in the skies arise from dust falling on the plates during their preparation, or from the use of a stronger solution of hyposulphite of soda for fixing than I have advised. This defect is easily remedied: but if it exists, its presence is hardly a grievance, as these orifices are so small as not to be produced in the positive proofs.

In conclusion I may remark, that the plan here recommended is such as may be used by the amateur on first trying this process, and is the same as employed by me in taking the specimens before you. Various modifications may be made; such as using less acid baths and more neutral collodion, so as to lessen the time of exposure; but I have preferred to give such proportions as would render success certain; for we all know that the more rapid a process is made, the more difficult it becomes. To the amateur, therefore, I would say, follow the plan I have given until you have mastered any difficulties that may occur, and can with certainty produce a picture; then, and *not till then*, decrease the amount of acidity in the various solutions, if a less amount of exposure is found desirable. Should any cause of disappointment arise which I have failed to notice, a letter addressed to me at Messrs. Horne and Thornthwaite, 123, Newgate Street, London, will be answered in the course of a post or two.

Note.—Since writing the above, the author has found that this process differs from all others with respect to the effect of acid in the baths and solutions; for while a decrease of acid in the collodion process increases the sensibility of the plate, in this it diminishes it. To obtain the greatest amount of sensibility with collodio-albumen, he now doubles the quantity of tincture of iodine in the iodized collodion, and adds to each pint of collodion-bath solution half an ounce of acetic acid, with an additional ounce of acetic acid to each pint of the albumen-bath solution. This plan is found to decrease the time of exposure by at least one half.

THE PRINTING PROCESS.

The paper for printing positives from glass or paper negatives is usually thicker than that employed for taking negatives on by the calotype, or waxed-paper process, and is designated "positive" paper. Various kinds are used, but we give the preference to Turner's positive, or the new German positive; both of which yield good results.

The kind of paper having been determined on, the sheets are examined one by one in order to reject those having black spots or minute holes, and a pencil mark is made in each corner of the sheet on its *smoothest* side, in order that this side may be easily recognized in the after processes.

In some kinds of paper the smoothest side is easily recognised; in others having a "water mark," it may be known by holding the sheet up to the light, so that the maker's name may be read (the letters not reversed), when the side *nearest* the operator is the smoothest. There are other kinds in which the two surfaces are rendered apparently alike by the pressure used in its manufacture, and in which no "water mark" exists. To recognize the required side in this case is more difficult, but still it is easily effected if one of the corners of each sheet is soaked in water for two minutes and then dried. As the smoothness given by the pressure is, by this plan, removed, the smoothest side is instantly determined.

The paper has now to be "salted," which consists in applying to it a solution of muriate of ammonia, which can be done by either brushing or immersion. But it must be carefully noticed that the solution for immersion is not strong enough for being brushed on.

SALTING PAPER BY IMMERSION

In order to salt paper by immersion, take a porcelain pan and fill it to a depth of half an inch with the following solution:—

Muriate of Ammonia . . .	1 scruple.	
Water	10 ounces.	Dissolve.

Into this solution carefully immerse one dozen sheets of paper, sheet by sheet, taking care to avoid air bubbles; after soaking five minutes, turn over the whole mass so as to commence at the sheet first immersed, and hang them one by one up to dry, on a line stretched across a room. The most convenient accessories for this purpose are "photographic pins," sold in boxes of four dozen at one shilling each box. The short limb of one of these pins is passed through one corner of each sheet, and the long limb is hooked over the line. After the sheet has drained a few minutes, a piece of filtering paper, about one inch square, is applied to the lowest corner, to which it will adhere, and much facilitate the removal of the superfluous moisture. Paper thus prepared will keep good any length of time.

SALTING PAPER BY BRUSHING.

Salting paper by brushing is prepared by the use of the following:—

Muriate of Ammonia . . . . 1 scruple.
Water . . . . 4 ounces. Dissolve.

Pin the sheet of paper, with the marked side uppermost, upon a "preparing board," and brush the above solution carefully over the whole surface with a camel-hair brush, applying the solution by longitudinal and then transverse strokes of the brush, so as to cover every part, and when the paper appears thoroughly wetted and will imbibe no more, drain off any superfluous moisture, and hang up to dry as above described. Paper thus prepared also keeps any length of time.

We will now suppose the operator has prepared a quantity of salted paper, by one or other of the above methods, and wishes to obtain a positive print from either a glass or paper negative.

EXCITING THE SALTED PAPER.

A sheet of the salted paper is first to be "excited," which may be done by the following solution:—

Nitrate of Silver . . . . . . 1 dram.
Distilled water . . . . . . 1 ounce. Dissolve.

To apply this solution, pin a piece of the salted paper upon a clean board, and with a soft camel-hair brush coat the surface thoroughly with the above nitrate of silver solution. CARE MUST BE TAKEN THAT THE SURFACE BE THOROUGHLY WETTED ALL OVER ALIKE, AND THIS CAN ONLY BE DONE BY APPLYING THE SOLUTION UNTIL THE PAPER CAN IMBIBE NO MORE, OR THE PICTURE WILL BE CERTAIN TO PRESENT STREAKS. A little practice will enable any one to apply the solution thoroughly to the paper, and yet have none to run off.

This being done, they must be dried in the dark, or, what is better, at once by the fire. Papers prepared in this manner are not like those excited for the camera, where every trace of white light must be excluded; these, on the contrary, may be prepared in any ordinary room *away from the window*, taking the precaution, as soon as they are dry, to put them in a portfolio.

Another plan of "exciting" the salted paper is by the employment of the ammoniacal nitrate of silver, as first suggested by Mr. Alfred Smee. This solution is prepared in the following manner. In a two-ounce stoppered bottle, place two drams of nitrate of silver, and pour over it one ounce of distilled water. When the crystals are dissolved, ammonia is added, a few drops at a time, and the bottle well shaken after each addition. The whole first becomes of a dark brown colour, from a precipitation of oxide of silver, but immediately the necessary quantity of ammonia is added, the solution becomes perfectly clear. A few crystals of nitrate of silver are now put in, just sufficient to cause a slight turbidness, the bottle has then to be filled up with distilled water, and the solution is ready for use.

In making this solution great care is required not to add an *excess* of ammonia, which can be avoided by allowing the solution to remain *slightly turbid.*

Salted paper is excited with the ammoniacal nitrate of silver solution in precisely the same manner as described for the plain nitrate of silver solution, of course not disturbing the precipitate which settles at the bottom of the bottle.

PRINTING POSITIVES ON PAPER.

The frames used for printing have been described in page 19, therefore it only remains to say that the negative must be placed upon the glass, face upwards, and the prepared paper, face downwards, upon this, face to face; then the back board, and the whole screwed moderately together. Very little pressure is required in the case of glass negatives.

The frame may now be carried into the light, and, in the case of a paper negative, exposed to the strongest sunlight; so also may many glass negatives, but a great many also of the latter are better printed by a good diffused light without the sun. This arises from the glass negatives, particularly when varnished, being more transparent; therefore, the sunlight, if very intense, is apt to flatten down the picture, whereas by printing in the shade, the darks, by giving more time, become quite as intense, and the whites more brilliant.

Most of the printing frames now used being jointed at the back, the picture may be examined, from time to time, to judge of its intensity, and, if not sufficiently printed, closed up again without being shifted, and again exposed to the light.

The printing process, as before observed, is very simple, but requires care, for if the picture be taken off too soon it will not fix up well, and if allowed to remain on too long it becomes too dark. *But it should be borne in mind that the printing must be carried deeper than is wanted in the finished picture, as a certain portion will be taken out in the fixing.* By attention to this, and with the use of the toning bath about to be described, almost any tone of picture may be obtained.

TONING THE PICTURE.

We must now suppose the picture properly printed. The next thing is to immerse it direct in the—

TONING BATH:

made as follows:—

Hyposulphite of soda	$2\frac{1}{2}$ ounces.
Chloride of gold	6 grains.
Common salt	2 scruples.
Nitrate of silver	1 dram.
Water	1 pint.

Dissolve the nitrate of silver in two ounces of distilled water, then add the common salt, stir well together, and allow the precipitate which forms to subside; pour away the upper clear fluid, and fill up again with water, allow to subside, and again pour off, three separate times; then add to the precipitate eighteen ounces of water and the hyposulphite of soda, and stir well together until dissolved; lastly, add the chloride of gold, previously dissolved in the remaining two ounces of distilled water, and it is ready for use.

The tone of picture produced by this bath will depend upon the intensity to which the printing has in the first instance been carried; therefore, if we want them to fix up very dark, we must print deep, to give the above solution time to produce the required tone; but if a warm brown is required, then less intensity will produce the result.

Having obtained the required colour, which may take from ten minutes to as many hours, remove the print from the toning bath, and fix by immersing it in the following solution:—

FIXING SOLUTION.

Hyposulphite of Soda . . .	3 ounces.
Water	1 pint. Dissolve.

Immerse the print in this bath for a quarter of an hour, then remove it and wash it with water, to remove the fixing solution as much as possible, and then plunge it into a vessel of water, which must be changed five or six times during the twenty-four hours the print must remain in it. After this drain, and pin up to dry.

Too much care cannot be used in removing every trace of the fixing solution, as this, if allowed to remain, causes the picture to fade.

It may be mentioned that the toning bath will "colour or tone" some scores of prints, if a grain or two of chloride of gold is added from time to time, when its action is slow, to give the required colour. The fixing solution should only be used to fix half a dozen prints, and be then thrown away, and a fresh solution employed for other prints.

But as pictures are not only printed upon salted paper but on the albumenized, it will be necessary to describe the method of making—

ALBUMENIZED PAPER.

Take any quantity of the white of egg, and mix with it an equal quantity of water. To each ounce of the mixture add ten grains of muriate of ammonia, and beat the whole into a froth. The more effectually this is done the better. Then stand the basin aside, that the clear liquid may settle down, and pour this off into a flat dish.

The paper, having been cut into the proper sizes, must be placed down upon this solution, and all air-bubbles avoided. This is best accomplished by beginning at one end and gradually pressing forward. Some considerable practice is required to make the paper properly, for the solution must be clear, bright, and free from air-bubbles.

Each sheet must remain on for a few minutes, and then be pinned up to dry. As soon as this is the case, a hot iron should be passed over the surface, to set the albumen and render it insoluble.

To excite for printing, dissolve two drams of nitrate of silver in three ounces of distilled water, and filter the solution into a flat dish.

Float each sheet upon it for ten minutes, and again pin up to dry in the dark.

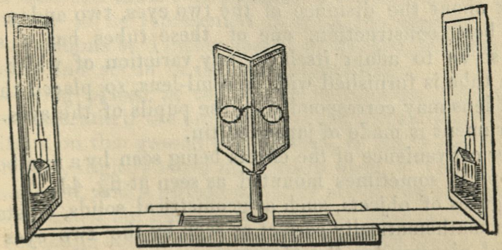
The mode of using is in every other respect the same as that described for the ordinary salted paper, but it has many advantages over that, not only in being able to print the most delicate tints, from the picture being so entirely upon the surface, but the sheet, if placed in a portfolio, will keep for days without change; whereas, with the ordinary salted, it must be used the same day as excited.

If the print has an unequal, mottled appearance, it indicates that the sheet of albumenized paper has not been allowed to remain on the nitrate of silver solution sufficiently long.

THE STEREOSCOPE.

This beautiful and now well known instrument, although capable of being constructed in a variety of forms, involves but one principle, the projection of a different perspective view of an object at the same moment to each eye. The two different impressions resolve themselves into one picture, which acquires the appearance of relief or solidity, from which circumstance the instrument has been named; the word Stereoscope being compounded of two Greek words, signifying *solid*, and *I see*. There are two convenient methods of causing the two pictures to be viewed at the same instant, either by two mirrors placed at about an angle of 90 degrees with each other, or by means of two half lenses. The following cut represents a reflecting stereoscope with mirrors, as first described by Professor Wheatstone, and is capable of showing pictures of any required size :—

Fig. 42.



Two plain mirrors are fixed on a centre support, capable of adjustment, which is fixed on a mahogany frame, and into this the two arms for holding the pictures slide. These arms have each adjustments in all directions, so as to bring the two pictures exactly coincident when viewed through the lenses placed in front of the mirrors. These lenses are not essential to the action of the instrument, but add much to the facility of use, and beauty of effect. In very perfect instruments, the mirrors are replaced by two polished prisms of glass.

The Lenticular Stereoscope, represented at fig. 43, as described by Sir David Brewster, consists of a frame or box of wood having an opening

Fig. 43.

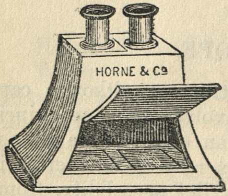
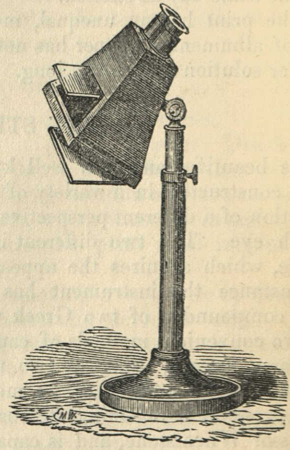


Fig. 44.



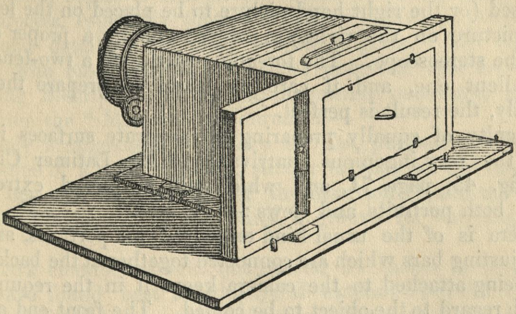
in front for admission of light, and mounted with two tubes or eye-pieces placed apart about the distance of the two eyes, two and a half inches; and in the best construction, one of these tubes has a slight lateral adjustment so as to adapt itself to any variation of width between the eyes. Each tube is furnished with a semi-lens, so placed that the centre of each half lens may correspond with the pupils of the eyes. A cheaper form of instrument is made of japanned tin.

For greater convenience of the effects being seen by a number of persons, the stereoscope is sometimes mounted as seen at fig. 44.

Outline figures of objects, such as geometrical solids, crystals, &c., that can be drawn mathematically correct as seen by the two eyes singly, produce beautiful pictures for the stereoscope, giving all the appearance of

perfect solidity; but for portraits, views, &c., photography affords the only means of obtaining sufficiently correct representations, upon the accuracy of which the almost magical effect of the stereoscope depends.

TO TAKE STEREOSCOPIC PICTURES.



STEREOSCOPIC CAMERA. Fig. 45.

For obtaining stereoscopic pictures of buildings, landscapes, statuary, and objects not likely to move, the ordinary view-camera is that usually employed. Having arranged the camera so that the required view is correctly represented on the ground glass, a pencil mark is made on its surface corresponding to some prominent object about the centre of the picture; the ground glass is now removed, and replaced by the frame containing the prepared paper or plate; when the impression is complete, the ground glass frame is again placed in the camera, and the whole apparatus is moved to another position parallel to the former, and as near as possible at the same distance from the object to be taken. The distance to be observed between these two positions is determined by the distance the nearest object to be represented is from the camera. If it be 50 feet, let the two positions be 6 inches apart; if 100 feet, 9 inches apart; 150 feet, 1 foot apart; and so on in the same proportion.

The camera being placed in the second position as determined by the rules just given, ascertain if the prominent object before referred to occupies the same position on the ground glass, which is easily ascertained by the pencil mark, if not, slightly move the camera until it does. The ground glass is now removed, and a picture taken as at the former position. The negatives thus obtained are printed, and the photographs from them viewed by either the reflecting stereoscope, (fig. 42), for large views, or the refracting instrument, (fig. 43), for small ones.

When the objects are likely to move or change during the time required to produce the two separate impressions, recourse must be had to a camera fitted with two lenses of *equal* focal length, which are placed one in each position, and at such an amount of inclination with regard to each other that the most prominent object occupies the same relative position on the ground glass of the camera; the two pictures are then taken simultaneously in the usual way, but the pictures so taken require to be reversed (or the right hand picture to be placed on the lef,t and the left hand picture on the right,) in order to obtain a proper effect when viewed in the stereoscope. The foregoing plan with a two-lens camera is a very excellent one, and if care be taken to prepare the paper or plates equally, the result is perfect.

The difficulty of equally preparing two separate surfaces is, however, avoided by the very ingenious contrivance of Mr. Latimer Clark, represented in fig. 45, page 71, and which will be found extremely convenient for both portraits and views :—

The camera is of the usual kind employed for portraits, and is placed upon two adjusting bars which are connected together at the back by another bar, which being attached to the camera keeps it in the required parallel position with regard to the object to be copied. The front end of one bar is attached to, and capable of being moved by, a tangent screw, by which the arc through which the camera moves is capable of adjustment to suit different distances.

At the back of the camera is fitted an oblong frame and slide, capable of holding a glass or other plate sufficiently large to form the two required pictures. In the centre of the frame is an opening of a proper size for one picture, and the whole is so arranged, that by pushing the camera from side to side it is moved through the proper distance for the stereoscopic picture; the prepared plate is thus exposed at two different parts to the influence of the two pictures formed by the lens.

The method of manipulating is very simple. The apparatus is placed opposite the object, the front bars adjusted for the distance, it is off, and the focus adjusted in the usual manner by means of the ground glass frame. The position of the adjusting bar is known to be correct when any one part of the object occupies the same position on the ground-glass when the camera slides from side to side. If it does not do so, the adjusting bar is altered by turning the head of the tangent screw either to the right or left until this effect is produced. The ground-glass frame is now removed, and the sliding back containing the prepared plate pushed into its place until it arrives at the brass spring stop, which tends to check its further advance. The camera is now drawn to the right-hand side, the door raised, and the cap of the lens removed for the time required to produce an impression; when the cap is replaced, the camera is moved to the left hand, the spring depressed, and the camera back pushed in to its fullest extent; the cap is again removed, and when an equal time has elapsed as

was given at the first exposure, the cap is replaced, the sliding door shut, and the back and plate removed into the dark room, and the operation completed, as described at page 41, and following pages.

PHOTOGRAPHS OF MICROSCOPIC OBJECTS.

Very beautiful copies of microscopic objects can be obtained by the photographic process, especially that with iodized collodion, possessing all the markings and detail of the most minute objects. Mr. J. Delves, of Tonbridge, who has produced some most beautiful specimens, has given the following description of the arrangements necessary, and which is extracted from the "Microscopic Journal": —

"The only arrangement necessary for the purpose is the addition to the microscope of a dark chamber, similar to that of the camera-obscura, having at one end an aperture for the insertion of the eye-piece end of the compound body, and at the other, a groove for carrying the ground-glass plate.

"This dark chamber should not exceed 24 inches in length (the size which I have found best to adopt): if extended beyond this, the pencil of light transmitted by the object-glass is diffused over too large a surface, and a faint and unsatisfactory picture is the result. The eye-piece must be removed from the compound body, and the object (being well illuminated by reflection from the concave mirror) must be adjusted and focussed upon the ground-glass plate.* In the production of positive pictures a slight difficulty here arises, dependent upon the 'over-correction' of the object-glass. The effect of this 'over-correction' is to project the blue rays of light beyond the other rays of the spectrum, and as the chemical properties of light reside in the violet and blue rays, it becomes necessary that the plane of the sensitive plate should coincide with the foci of these rays, and it must therefore be placed beyond the surface at which the best definition is seen; this amounts to some distance with the lower combinations, and decreases with the increase of magnifying power.

"For the production of *negative* pictures, the ordinary illumination is not sufficient, and recourse must be had to the sunbeam, which should be reflected upon the object by the plane mirror when powers are used not exceeding the quarter of an inch combination. It is not necessary here (when producing negatives by the sunbeam) to allow for the 'over-correction' of the object-glass, but merely to focus the object carefully upon the ground-glass plate.

"In the production of negative pictures, a moment's exposure to the sunbeam is sufficient when using the lowest powers, and with the highest I have varied the time from five to ten seconds."

* The microscope must be placed in a perfectly horizontal position, in order to adapt it to the dark chamber.

[illegible] the first exposure, the cap is replaced, the sliding door [illegible] and the plate removed into the dark room, and the operation [illegible], as described in page 31, and following pages.

PHOTOGRAPHS OF MICROSCOPIC OBJECTS.

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